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NATIONAL DAM SAFETY PROGRAM. PALMER FALLS DAM. UPPER HUDSON RIV--ETC(U)
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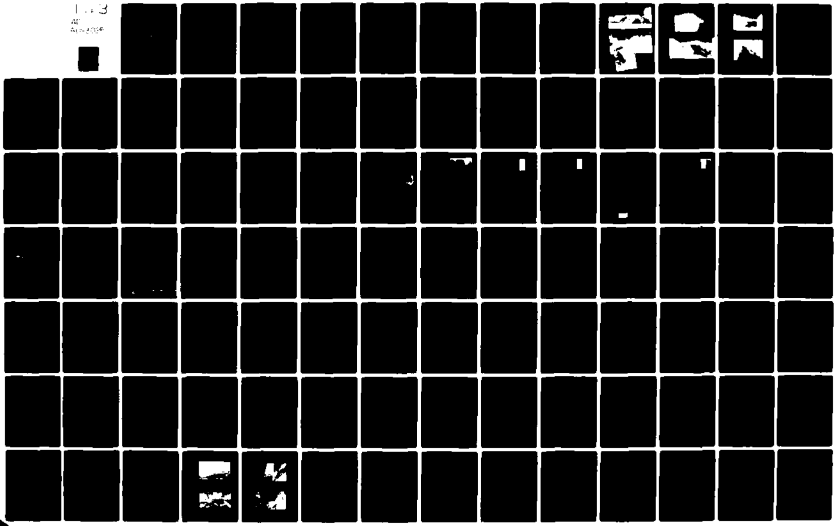

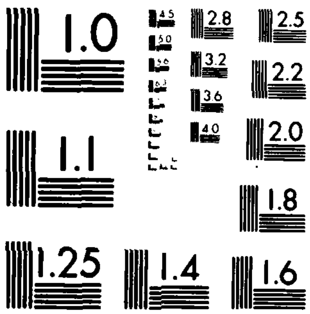

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Plamer Falls Dam
Saratoga
Warren
Hudson River

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

The examination of documents and visual inspection of the dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. However, the structural stability of the dam, the condition of the concrete and the extent of seepage through the concrete should

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be investigated further.

The structural stability analysis indicates unsatisfactory stability against overturning for the cases where the dam is subjected to forces possible during winter operation (including ice loading), the Probable Maximum Flood (PMF), and 1/2 PMF conditions. Additional investigations should be undertaken immediately to fully evaluate the structural stability of the dam. These investigations should consist of a physical examination of the structure with the impoundment drawn down so as to provide a view of the spillway concrete and a detailed inspection of the interior of the dam to determine the structural condition of the concrete and leakage through construction joints. The walkway through the interior of the dam should be repaired so that the inspection of the interior of the dam can be performed. Investigations should also be undertaken to evaluate the presence and magnitude of uplift forces acting on the dam. This study should also include an investigation and evaluation of the structural condition of the rock underlying the dam and immediately downstream. Dam stability studies based on actual existing conditions should then be performed. If necessary, recommendations to improve the stability should be developed. The recommended remedial measures should be completed within two years.

Hydrologic/hydraulic analysis performed in accordance with the Corps of Engineers Recommended Guidelines for Safety Inspection of Dams establishes the spillway capacity as 23% of the Probable Maximum Flood (PMF). The dam will be overtopped by 20.6 feet and 8.1 feet by the PMF and 1/2 PMF respectively. However, in the opinion of the inspection team, failure of the dam during the 1/2 PMF would not significantly increase the downstream hazard from that which would occur just prior to dam failure due to the small reservoir volume relative to the high flood flows. Therefore, the spillway is inadequate according to the Corps of Engineers screening criteria.

The following measures should be undertaken within one year:

1. A formalized inspection program should be initiated to develop data on conditions and maintenance operations at the facility.

2. A flood warning and emergency evacuation plan should be developed and implemented to alert the public in the event conditions occur which could result in failure of the dam.

DISCLAIMER NOTICE

UPPER HUDSON RIVER BASIN

PALMER FALLS DAM
SARATOGA & WARREN COUNTIES
NEW YORK

INVENTORY Nº NY 145

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PHASE I INSPECTION REPORT
6 NATIONAL DAM SAFETY PROGRAM.

Palmer Falls Dam, ~~(Inventory Number NY 145)~~, Upper Hudson River Basin, Saratoga and Warren Counties, New York. Phase I Inspection Report,

APPROVED FOR PUBLIC RELEASE; 14 NY-145

CONTRACT NO. DACW51-79-C-0001

10 John B. Stetson

NEW YORK DISTRICT CORPS OF ENGINEERS

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam Palmer Falls Dam, NY145

State Located New York
County Located Saratoga and Warren
Stream Hudson River
Date of Inspection April 21, 1980, May 18, 1980

ASSESSMENT OF GENERAL CONDITIONS

The examination of documents and visual inspection of the dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. However, the structural stability of the dam, the condition of the concrete and the extent of seepage through the concrete should be investigated further.

The structural stability analysis indicates unsatisfactory stability against overturning for the cases where the dam is subjected to forces possible during winter operation (including ice loading), the Probable Maximum Flood (PMF), and 1/2 PMF conditions. Additional investigations should be undertaken immediately to fully evaluate the structural stability of the dam. These investigations should consist of a physical examination of the structure with the impoundment drawn down so as to provide a view of the spillway concrete and a detailed inspection of the interior of the dam to determine the structural condition of the concrete and leakage through construction joints. The walkway through the interior of the dam should be repaired so that the inspection of the interior of the dam can be performed. Investigations should also be undertaken to evaluate the presence and magnitude of uplift forces acting on the dam. This study should also include an investigation and evaluation of the structural condition of the rock underlying the dam and immediately downstream. Dam stability studies based on actual existing conditions should then be performed. If necessary, recommendations to improve the stability should be developed. The recommended remedial measures should be completed within two years.

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The following measures should be undertaken within one year:

1. A formalized inspection program should be initiated to develop data on conditions and maintenance operations at the facility.

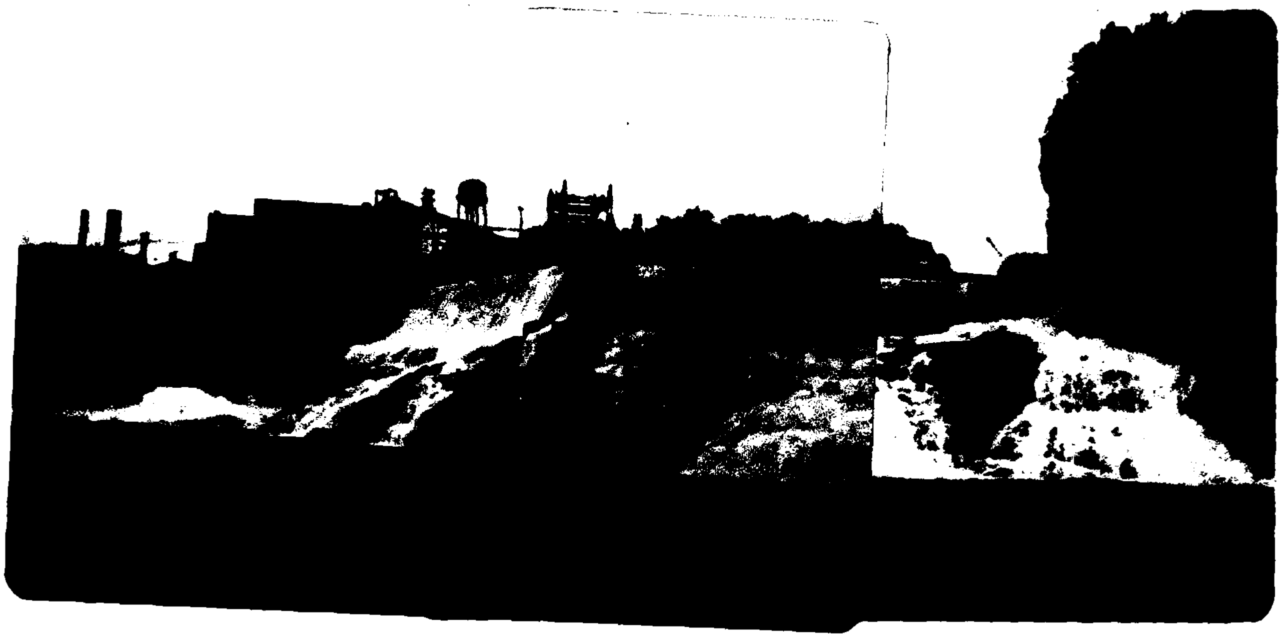
2. A flood warning and emergency evacuation plan should be developed and implemented to alert the public in the event conditions occur which could result in failure of the dam.

Dale Engineering Company

John B. Stetson, President

Approved By: Col. W.M. Smith, Jr.
New York District Engineer

Date: 28 AUG 1980

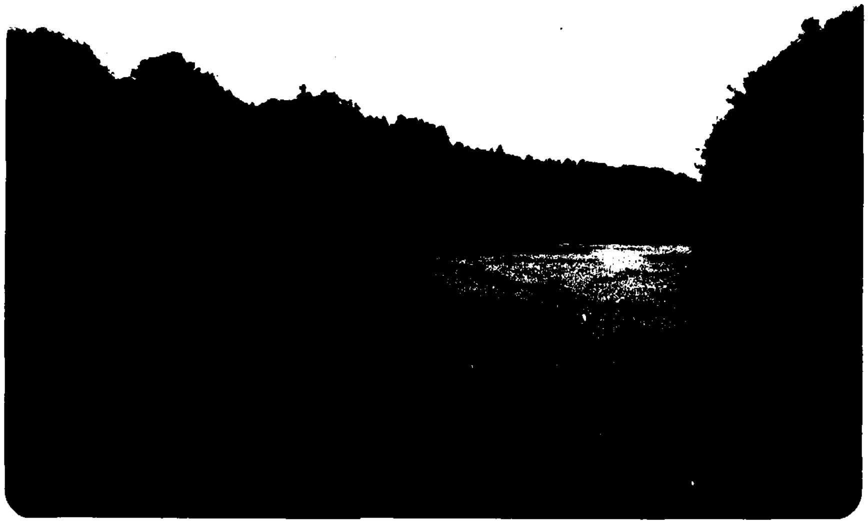


1. View of Dam from downstream.


2. View of Dam from west abutment. International Paper Company, Hudson River Mill in background.

3. West abutment of Dam.

4. East abutment of Dam and spillway from single level forebay at upper left. Low level forebay in foreground.



5. View of impoundment from east abutment.

6. View of receiving stream from east abutment.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM - PALMER FALLS DAM   ID# - NY 145

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

Authority for this report is provided by the National Dam Inspection Act, Public Law 92-367 of 1972. It has been prepared in accordance with a contract for professional services between Dale Engineering Company and The New York State Department of Environmental Conservation.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the existing condition of the Palmer Falls Dam and appurtenant structures, owned by the International Paper Company, and to determine if the dam constitutes a hazard to human life or property and to transmit findings to the State of New York.

This Phase I inspection report does not relieve an Owner or Operator of a dam of the legal duties, obligations or liabilities associated with the ownership or operation of the dam. In addition, due to the limited scope of services for these Phase I investigations, the investigators had to rely upon the data furnished to them. Therefore, this investigation is limited to visual inspection, review of data prepared by others, and simplified hydrologic, hydraulic and structural stability evaluations where appropriate. The investigators do not assume responsibility for defects or deficiencies in the dam or in the data provided.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The Palmer Falls Dam is situated on the Hudson River, in the Village of Corinth, New York. The dam is a V-shaped structure situated at the top of Palmer Falls, a natural waterfall in the river. The structure is approximately 557 feet long and 37 feet high. The spillway of the dam is an Ambursen type, concrete buttress structure. The easterly leg of the V-shaped spillway is constructed with an ogee shaped concrete spillway while the westerly portion is constructed with the buttresses exposed on the downstream face. The spillway section is normally equipped with flashboards 46 inches high. The International Paper Company, Hudson River Mill No. 3 is situated on the east abutment of the dam. A sluice gate structure approximately 196 feet long and accommodating 8 sluice gates controls flow into the

forebay of the power generating facility at the Paper Company Mill. The major spillway section of the dam forms a V at the crest of Palmer Falls and extends the full width of the river to the west abutment. The point of the V is in the downstream direction. The total length of the spillway section is approximately 346 feet. The dam is situated on rock.

The sluice gates control flow into the forebay of the power generating station of the Paper Mill. This generating station allows power to be generated either from the full head of the impoundment or by discharging flows from the upper level forebay into a lower level forebay which allows power to be generated at approximately 1/2 of the total head in the impoundment.

b. <u>Location</u>

The Palmer Falls Dam is located in the Village of Corinth, Town of Corinth, Saratoga County, New York and in the Town of Lake Luzerne, Warren County, New York.

c. <u>Size Classification</u>

The maximum height of the dam is approximately 37 feet. The storage volume of the impoundment is approximately 358 acre feet. Therefore, the dam is in the Small Size Classification as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. <u>Hazard Classification</u>

The Hudson River, downstream from the impoundment, is used extensively for recreational purposes. The International Paper Company Hudson Mill is located on the east abutment of the dam. Therefore, the dam is in the High Hazard Category as defined by the Recommended Guidelines for Safety Inspection of Dams.

e. <u>Ownership</u>

The dam is owned by the International Paper Company.

Contact: International Paper Company
Pine Street
Corinth, New York 12822
Attention: Richard O'Brien, Plant Manager
Telephone: 518-654-9031

f. Purpose of Dam

The dam is used for power generating and as a source of process water by the International Paper Company.

g. Design and Construction History

The present dam was constructed in 1914 to replace a dam located a short distance upstream which was damaged during the floods of March, 1913. Correspondence included in Appendix B indicates that construction of the dam was started before the formal approval by the New York State Conservation Commission. In August of 1913, construction was halted by order of the Commissioner of the Conservation Commission until foundation problems on the easterly leg of the spillway section were resolved to the satisfaction of the Conservation Commission. The plans were subsequently revised to move the easterly leg of the spillway upstream and allow for construction of an ogee shaped spillway ramp which directed the water in a horizontal direction at the toe of the dam. This apparently eliminated to the satisfaction of the Conservation Commission the cause of probable erosion to the face of the natural waterfalls. The correspondence indicates that the dam was completed in late January of 1914.

h. Normal Operational Procedures

The facility is operated by the International Paper Company. The principal use of the facility is for power generation and as a source of process water. Normal operation of the facility consists of regulating the level of the impoundment for optimum power generation and process water availability. This is accomplished by the manipulation of the gates which control flow into the forebay of the mill.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of Palmer Falls Dam, ID# NY145, is 2757 square miles.

b. Discharge at Dam Site

No discharge records are available for this site.

Computed Discharges:

Ungated Spillway, Top of Dam (Without Flashboards)	66050	cfs
Ungated Spillway (With 46" Flashboards)	40200	cfs
Gated Drawdown (Through 2, 12'x12' Gated Outlets in Upper Forebay)	2090	cfs (@ elev. 517.17)

c. Elevation (Feet Above MSL)

Top of Dam	531.67
Spillway Crest	517.17
	520.92 with flashboards
Stream Bed at Centerline of Dam	479.7

d. Reservoir

Length of Normal Pool (With Flashboards)	2050 FT

e. Storage

Top of Dam	561 Acre Feet
Normal Pool (With Flashboards)	358 Acre Feet
Normal Pool (Without Flashboards)	284 Acre Feet

f. Reservoir Area

Top of Dam	22 Acres
Spillway Pool	15 Acres

g. Dam

Type - Buttressed Concrete.
Length - 557 Feet.
Height - 37.5 Feet.
Freeboard Between Normal Reservoir and Top of Dam - 10.75 Feet.
Top Width - 12 Feet (Nominal).
Side Slopes - Upstream - 1 Horizontal, 0.75 Vertical; Downstream - 1 Horizontal, 1.75 Vertical.
Zoning - N/A.
Impervious Core - N/A.
Grout Curtain - N/A.

h. Spillway

Type - Ogee Crest.
Length - 346 Feet.
Crest Elevation - 517.17, with Flashboards - 520.92.
Gates - None.
U/S Channel - Natural.
D/S Channel - Natural - Rock.

i. Regulating Outlets

8 gates approximately 13 feet x 14 feet, controlling flow into upper forebay.

SECTION 2 - ENGINEERING DATA

2.1 GEOTECHNICAL DATA

The Palmer Falls Dam is situated entirely on bedrock. Appendix B has numerous references to the quality of the foundation material and also includes photographs of the site during construction.

2.2 DESIGN RECORDS

Appendix B also includes the original design calculations for the dam as well as design calculations developed by the Conservation Commission of the State of New York.

2.3 CONSTRUCTION RECORDS

Appendix B includes numerous inspection reports which took place during the construction of the dam.

2.4 OPERATION RECORDS

There are no Operation Records available for this dam.

2.5 EVALUATION OF DATA

The data presented in this report was obtained from the Department of Environmental Conservation files. The information available appears to be reliable and adequate for Phase I inspection purposes.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The Palmer Falls Dam was inspected on April 21, 1980. The Dale Engineering Company Inspection Team was accompanied on this inspection by Robert Talbot, Supervisor of Engineering Services for the International Paper Company. At the time of this inspection, flow in the river was approximatley 20,000 cfs. This flow across the spillway section of the dam obscured much of the structure from view. A subsequent inspection was performed on May 18, 1980 during a period when flow was substantially less but still great enough to partially obscure the structure from view.

b. Dam

The second inspection of the Palmer Falls Dam was conducted when some flow was cresting the spillway, however, observation of the spillway surface was made through the water. The surface of the easterly wing of the V-shaped dam appears to be in good condition. Some slight surface spalling was noted through the water and horizontal joints in the concrete were also visible. The log chute in the center of the V of the dam shows some deterioration of the concrete but no structural cracking was detected when viewed from a distance. The westerly leg of the V-shaped spillway was viewed both from above the west abutment and from the receiving pool downstream from the dam. These vantage points did not offer a close enough view so that the condition of the concrete could be determined, however, the alignment of the structure does not indicate displacement of structural members. The interior of the structure was not inspected because of the hazardous condition of the walkway between the buttresses. Some leakage reputedly takes place through the concrete into the interior of the dam.

c. Appurtenant Structures

The easterly abutment wall shows some surface spalling of the concrete to the depth of approximately 3 to 4 inches in some places. Minor surface spalling was also noted on the walkways around the gates controlling flow into the forebay. Recent concrete repairs had taken place in this area.

d. Control Outlet

The sluice gates controlling flow into the forebay of the paper mill are in operating condition and were fully opened at the time of the inspection. These gates are pneumatically operated and the operating mechanism was in good condition.

e. Reservoir Area

The Palmer Falls Dam is a run-of-river structure and the impoundment is defined by the original banks of the Hudson River. This impoundment extends approximately 1/2 mile to an upstream dam also owned by International Paper Company. The banks of the Hudson River in this area are formed in rock and no evidence of bank instability was noted.

f. Downstream Channel

The downstream channel is also formed in bedrock and no evidence of recent erosion was noted.

3.2 EVALUATION

Although flow conditions at the dam precluded a close inspection of the spillway surface, there was no evidence that severe deterioration of the concrete has taken place. Flow over the ogee shaped spillway which comprises the easterly leg of the dam was generally smooth and no irregularities in flow were noted which would indicate severe surface deterioration. Field observations did not disclose evidence of displacement of the structure and no conditions were detected which would indicate structural instability.

Minor deterioration of concrete surfaces was detected on the east abutment wall, however, this deterioration was not severe and steps had been taken to repair spalled concrete on the walkways.

The walkway through the interior of the dam should be repaired so that inspections may be made of the structural elements of the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The normal operating procedure for this structure is to control the water level in the impoundment for optimum use for power generation and process water for paper manufacturing.

4.2 MAINTENANCE OF THE DAM

Maintenance and operation of the dam is controlled by the International Paper Company. The dam is immediately adjacent to the facilities of International Paper Company and is in constant surveillance by their personnel. No formal reporting system is in effect regarding the condition of the dam. Inspection of the interior of the dam is presently prohibited due to the dangerous condition of the walkway between the buttresses.

4.3 MAINTENANCE OF OPERATING FACILITIES

The gates controlling the flow to the forebay of the power generating facilities are in operating condition and are checked periodically by personnel of the International Paper Company.

4.4 DESCRIPTION OF WARNING SYSTEM

No warning system is in effect at present.

4.5 EVALUATION

The dam and appurtenances are in constant surveillance by personnel from the International Paper Company. The facility is generally in satisfactory operating condition. Deterioration of the walkway through the dam prohibits access to the core for inspection purposes. There is no other evidence of deterioration caused by lack of maintenance. Because the dam is in the High Hazard Classification, a warning system should be implemented to alert the public, should conditions occur which could result in failure of the dam.

SECTION 5 - HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

The Palmer Falls Dam is located on the Warren and Saratoga County line in the Village of Corinth. The dam is situated on the Hudson River, which has a drainage area of approximately 2,757 square miles upstream of the site. The Upper Hudson River is a rather complex river system which includes such major tributaries as Schroon River, Cedar River and Sacandaga River. The major lakes in the river system upstream of the dam include Schroon Lake, Brant Lake, Indian Lake and Great Sacandaga Lake.

5.2 ANALYSIS CRITERIA

The purpose of this investigation is to evaluate the dam and spillway with respect to their flood control potential and adequacy. This has been assessed through the evaluation of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the flood through the reservoir and the dam's spillway system. The PMF event is that hypothetical flow induced by the most critical combination of precipitation, minimum infiltration loss and concentration of run-off of a specific location that is considered reasonably possible for a particular drainage area.

The hydraulic analysis is performed to determine the capacity of the spillway and to determine the extent of the overtopping of the dam which could occur during the PMF. In establishing the spillway capacity, it was assumed that no flashboards were in place on the spillway. It should be noted that the placement of flashboards will further decrease the spillway capacity so that overtopping could occur at lesser flows than those indicated in this analysis if the flashboards do not fail before overtopping occurs.

The hydrologic analysis was performed using the unit hydrograph method to develop the flood hydrograph. Due to the limited scope of this Phase I investigation, certain assumptions, based on experience and existing data were used in this analysis and in the determination of the dam's spillway capacity to pass the PMF. In the event that the dam could not pass one-half the Probable Maximum Flood without overtopping, additional analyses are to be performed on potential dam failures if the dam is designated as a High Hazard Classification. This process was done with the concept that if the dam was unable to satisfy this criteria, further refined hydrologic investigations would be required.

An HEC-1 computer model for the basin was published by the New York District Corps of Engineers in a report entitled Upper Hudson and Mohawk River Basins Hydrologic Flood Routing Models, dated October 1976 (Ref. 19). The report was reviewed for the purpose of this investigation and the model which was used for the preparation of this report was obtained from the New York District. The model was recoded and executed for analysis of the PMF. No changes were made to

the unit hydrograph, base flow, loss rate or routing parameters. A smaller sub-area was added to the model to determine flows at the Palmer Falls Dam. The unit hydrograph parameters and base flow for this new sub-area were estimated from equations presented in the aforementioned report.

The U.S. Army Corps of Engineers' Hydrologic Engineering Center's Computer Program HEC-1DB was utilized to evaluate the PMF hydrology. The Probable Maximum Precipitation (PMP) was 20.6 inches according to Hydrometeorological Report (HMR #51) for a 24-hour duration storm, 200 square mile basin. HMR #51 was used in lieu of HMR #33 because the drainage area exceeded the applicable limits of HMR #33. The loss rates used in the PMF analysis were those used in the Transposed Agnes Storm and SPF analysis published in the Upper Hudson and Mohawk River Basins report. These loss rates incorporated an initial abstraction of 1.0 to 2.0 inches and a continuous loss rate of 0.075 inches/hour. The loss rate function yielded 74 percent run-off from the PMF. The peak for the PMF inflow hydrograph was 282,570 cfs and the 1/2 PMF inflow peak was 140,770 cfs. The small storage capacity resulted in the peak outflows being essentially equal to the peak inflows. It should be noted that flows in the Upper Hudson River from any storm may be regulated appreciably by Great Sacandaga Lake and Indian Lake. Such time-varying operation was not simulated with the HEC-1 model.

5.3 SPILLWAY CAPACITY

The spillway is an Ambursen-type structure with a sloping upstream face and a rounded crest. Weir coefficients ranging from 3.1 to 3.65 over the heads encountered in routing the PMF were assigned for the spillway rating curve development. In the PMF evaluation, flow through the forebay gates and flow through the mill were not considered. The discharge capacity of the spillway at the top of dam elevation is 66,050 cfs with no flashboards in place. The spillway capacity with 46 inches of flashboards is 40,200 cfs.

SPILLWAY CAPACITY (WITHOUT FLASHBOARDS)

Flood	Peak Discharge	Capacity as % of Flood Discharge
PMF	282,567 cfs	23.4%
1/2 PMF	140,777 cfs	46.9%

5.4 RESERVOIR CAPACITY

The reservoir storage capacity was estimated from USGS mapping and available riverbed information at Palmer Falls and Curtis Falls dams.

The resulting estimates of the reservoir storage capacity are shown below:

Top of Dam	561 Acre-Feet
Spillway Crest	284 Acre-Feet

5.5 FLOODS OF RECORD

There are no accurate records of flood discharges at the site. A review of pertinent publications revealed the maximum discharges shown below for sites on the Hudson River near the dam site (Ref. 21).

Hudson River Gage Location	Drainage Area (Sq. Mi.)	Period of Record	Date	Maximum Discharge(cfs)
Corinth, NY	2755	1905-1912	4/16/09	41,400
Spier Falls, NY	2799	1900-1922	3/28/13	89,100
Ft. Edward, NY	2817	1896-1904	4/23/00	43,900

It should be noted that these flood discharges occurred before construction for the present structure and were not affected as much by the regulating capability of the Great Sacandaga Lake as present or future flood flows would be.

5.6 OVERTOPPING POTENTIAL

The HEC-1 DB analysis indicates that the dam will be overtopped as follows:

Flood	Maximum Depth Over Dam
PMF	20.6 Feet
1/2 PMF	8.1 Feet

5.7 EVALUATION

The spillway is inadequate to pass Probable Maximum Flood (PMF) without overtopping the dam, as the spillway capacity is 23% of the PMF. However, in the opinion of the inspection team, failure of the dam during the 1/2 PMF would not significantly increase the downstream hazard from that which would occur just prior to dam failure due to the small reservoir volume relative to the high flood flows. Therefore, the spillway is assessed as inadequate according to the Corps of Engineers screening criteria.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Palmer Falls Dam is situated at the crest of a natural rock ledge-waterfall in the Hudson River. The dam is "V-shaped" and comprised of two sections to generally follow the natural alignment of the rock ledge. A constructed abutment, of concrete, at the point of the dam's "V" serves to join the two sections. The westerly, or left abutment looking downsteam, is sited into rock. The dam's right abutment, also founded in rock, adjoins the forebay structure for the International Paper Company hydropower facility-production plant situated on the east bank of the river.

The westerly dam section is an Ambursen design (downstream face unsurfaced). The easterly section represents a modification of the Ambursen design, being a buttressed structure with the downstream side concrete surfaced.

Both dam sections function as a spillway. Flashboards in place were being crested at the time two field inspections were performed. Spillway flow interfered with access to and observation of much of the dam surface. The interior of the dam could not be examined because of the unsafe conditon of the walkway. Some leakage reputedly takes place through the concrete into the interior of the dam. However, observations indicate the dam retains structural stability and no sign of structural movement was evident. Some surface deterioration and spalling has occurred along the dam spillway sections and abutment structures. The spillway flow prevented examinations of the rock at the toe of the dam and investigation for erosion and underdam seepage.

b. Geology and Seismic Stability

Geologically, Palmer Falls is located in the eastern part of the Adirondack Province.

The dam foundation and both abutments are sited in bedrock of granitic to syenitic gneissses. This material is hard, dense, durable, resistant, and impermeable. Weathering is very minor.

At the east abutment the gneiss foliation strikes N80E and dips 10°-13° NW. The dip is, generally, in the downstream direction.

State reports of 1913 mention the dip as being anywhere from 10° to 20° downstream. Although the foliation is generally tight and closely spaced (1 to 3 mm), foliation open cracks exist and range in spacing from 2 to 8 inches.

Two prominent joint sets are present at the east abutment as follows:

Set	Strike	Dip	Spacing
1	N10E	90	2-1/2"-5"
2	N80-85E	80-85E	2-1/3"-8"

The rock structure therefore presents readily available blocks which are susceptible to movement by hydraulic action and frost wedging.

The included Geologic Map shows several faults which are located in the vicinity of the dam site. Several 1913 State reports which discuss construction of the present dam indicate a fault is at the dam and essentially parallel to the longitudinal axis. This fault was reported to be practically vertical with a trench eroded along that zone to a depth of 30 to 40 feet.

A fault about two miles west of the dam, known as Hoffman's fault, has a vertical displacement estimated as being from 1,000 to 1,600 feet. Another fault, situated about five miles east of the dam, has a vertical displacement of about 4,900 feet.

Information on some of the larger earthquakes recorded for the area appears below. Many earthquakes of less intensity are known to have occurred in this region, according to the New York State Geologic Survey, but none are in the immediate vicinity of the dam.

Date	Intensity Modified Mercalli	Location Relative to Dam
1847	III	7 mi. NE
1855	IV	14 mi. NNE
1916a	IV-V	26 mi. SW
1916b	V	7 mi. NE
1917	III	12 mi. ENE
1921a	IV	7 mi. NE
1921b	IV	7 mi. NE
1931	VII	13 mi. NNE
1955	V	20 mi. S
1974	IV-V	9 mi. N

The dam is located in an area having a Zone 2 Seismic Probability Designation. However, the area is considered to have the potential for a Zone 3 designation.

Concerning the fault existing at the dam site, if the trench (formed by erosion along the fault) was not properly filled or grouted, a significant potential zone of weakness will exist. Similarly, if the joints and foliation plane openings were not grouted, the potential for significant uplift is increased. It is also possible that the water falling on the bedrock at the toe may have accomplished some undermining.

The high (about 80 feet) steep walls above the impoundment area are considered subject to some rock fall (the result of frost wedging). The walls are not likely to experience a rock slide. A moderate to severe earthquake would increase the rock fall potential while movement along the fault underlying the dam would weaken the dam foundation and increase its susceptibility to sliding and uplift.

c. Stability Evaluation

Design drawings available for review show a plan alignment and cross-sections for the dam spillway sections but do not include information on the properties of the dam and foundation materials. Some previously performed stability computations are available (1913) for review but it is not certain that these analyses refer to the as-built conditions for the dam's actual location. As part of the present study, stability evaluations have been performed for the dam spillway sections. Actual properties of the dam's construction materials and foundations were not determined as part of this study; where information on properties were necessary for computations but lacking, assumptions felt to be practical were made. The stability computations assumed a structural cross-section based on dimensions indicated by the plans included in this report. It should be considered that in areas where deterioration has occurred, section dimensions would be less than indicated by the plans, with some adverse affect on the structural strength expected. The analysis also assumed dam sections to be monoliths possessing necessary internal resistance to shear and bending occurring as a result of loading.

The results of the stability computations are summarized in the table following this page. The stability analysis are presented in Appendix D.

The rock surface underlying the dam varies in elevation, a condition which effects the height of the dam's different sections. Cross-sections assumed for analysis are representative of the higher, and presumably more critical, dam areas.

The analysis indicates that both the easterly and westerly dam sections are stable against overturning and sliding effects under the normal summer operations condition which includes flashboards in place. Instability, but marginally so, is indicated for both dam sections subject to forces possible under winter operating conditions which include the effects of ice, according to the U.S. Corps of Engineers Recommended Guidelines for Safety Inspection of Dams (i.e., where the resultant of forces acting on the dam is located outside the middle third of the base or plan analyzed, tensile stress would develop in the dam section, a condition which is structurally undesirable because of the very low design tensile strength of concrete.)

Both dam sections show satisfactory stability for the condition where seismic effects are imposed onto the forces which occur from the normal summer operating condition.

RESULTS OF STABILITY COMPUTATIONS

	Loading Condition	Factor of Safety* Overturning	Factor of Safety* Sliding**	Location of Resultant Passing through Base***
Easterly Section				
(1)	Normal operating condition of water level at top of flashboards, uplift on base (base considered equal to dam plan area)	1.37	6±	0.33b
(2)	Water level at top of flashboards, 7.5 kip per foot ice load acting, uplift on base	1.32	3±	0.30b
(3)	1/2 PMF conditions, with water level against upstream face and above dam based on 1/2 PMF elevation			
	(a) uplift on base as computed for normal operating condition	1.73	3.8±	0.41b
	(b) uplift based on full headwater hydrostatic pressure at heel	1.29	3.5±	0.31b
(4)	PMF conditions, with water level against upstream face and above dam based on PMF elevation			
	(a) uplift on base as computed for normal operating condition	1.93	3.1±	0.44b
	(b) uplift based on full headwater hydrostatic pressure at heel	1.25	2.7±	0.30b
(5)	Normal operating condition (water level at top of flashboards) plus seismic effects applicable to Zone 2	1.32	5±	0.31b

* These factors of safety indicate the ratio of moments resisting overturning to those moments causing overturning, and the ratio of forces resisting sliding to those causing sliding.

** As determined applying the friction-shear method.

*** Indicated in terms of the dam's base dimension, b, measured from the toe of the dam.

RESULTS OF STABILITY COMPUTATIONS - (CONTINUED)

Loading Condition		Factor of Safety* Overturning	Factor of Safety* Sliding**	Location of Resultant Passing through Base***
Westerly Section				
(6)	Normal operating condition of water level at top of flashboards, uplift on base where			
	(a) base equals plan area of dam	1.41	14±	0.35b
	(b) base equals foundation contact area only, area between buttresses excluded	1.78	7±	0.38b
(7)	Water level at top of flashboards, 7.5 kip per lineal foot ice load acting, uplift on base			
	(a) base equals plan area of dam	1.27	more than 5.5	0.26b
	(b) base equals foundation contact area only	1.57	5.5±	0.32b
(8)	1/2 PMF conditions, with water level against upstream face and above dam based on 1/2 PMF elevation, uplift on base as computed for normal operating condition			
	(a) base equals plan area of dam	1.47	greater than for (b)	0.28b
	(b) base equals foundation contact area only	greater than for (a)	3.3±	---

* These factors of safety indicate the ratio of moments resisting overturning to those moments causing overturning, and the ratio of forces resisting sliding to those causing sliding.

** As determined applying the friction-shear method.

*** Indicated in terms of the dam's base dimension, b, measured from the toe of the dam.

RESULTS OF STABILITY COMPUTATIONS - (CONTINUED)

	Loading Condition	Factor of Safety* Overturning	Factor of Safety* Sliding**	Location of Resultant Passing through Base***
(9)	PMF conditions, with water level against upstream face and above dam based on PMF elevation, uplift on base as computed for normal operating condition			
	(a) base equals plan area of dam	1.59	greater than for (b)	0.31b
	(b) base equals foundation contact area only	greater than for (a)	2.9$\pm$	--
(10)	Normal operating condition (water level at top of flashboards), seismic effects applicable to Zone 2, uplift on base			
	(a) base equals plan area of dam	1.36	greater than for (b)	0.34b
	(b) base equals foundation contact area only	greater than for (a)	6$\pm$	--

* These factors of safety indicate the ratio of moments resisting overturning to those moments causing overturning, and the ratio of forces resisting sliding to those causing sliding.

** As determined applying the friction-shear method.

*** Indicated in terms of the dam's base dimension, b, measured from the toe of the dam.

For the dam subject to the 1/2 PMF and PMF condition, a number of different possible uplift effects were studied. At this site, it is considered that the jointing, foliation cracks and bedding present in the foundation rock creates the possibility that uplift will act at the base of the dam. Accordingly, the easterly section of the dam was analyzed for the condition where the uplift force at a 1/2 PMF and PMF occurrence remained equal to the uplift possible under a normal operations condition (this would assume that the rock permeability and seepage was limited) and also for the more severe condition where the uplift related to pressures resulting from the actual upstream water level present during the 1/2 PMF or PMF. For each uplift condition, the hydrostatic pressure acting at the dam's upstream edge was based upon the appropriate headwater elevation, (the "normal operations" or flood level elevation), while a zero tailwater elevation and hydrostatic pressure was assumed at the dam's downstream edge. Uplift was assumed to vary linearly between a section's upstream and downstream faces, and act upon 100 percent of the dam base/section. For the easterly section, adequate stability is indicated with the "normal operations" uplift in effect but unsatisfactory stability results where the uplift is based upon the 1/2 PMF or PMF upstream level.

The westerly dam section exists with the downstream face open between buttress locations. The possibilities that uplift could act on a base equal to the dam's plan area or act only on the actual area in contact with the foundation rock (open area between buttresses is not considered as part of the base) were studied. For both these cases, an uplift developed from the normal operations condition was applied to the assumed base area, The resulting computations indicate unsatisfactory stability against overturning for the assumption of uplift acting upon a base with dimensions equal to the dam plan area, and unsatisfactory resistance to sliding (factors of safety less than four) for the assumption of uplift acting on only the foundation contact area. Lesser factors of safety (less stability) than shown in the tabulated summary would apply to the more severe condition where uplift pressures are based upon actual upstream flood water elevations. When evaluating the 1/2 PMF and PMF cases, the analysis assumed that lateral and vertical pressures acting against the back face of the dam related to the upstream flood level, with no water pressures acting against the dam's downstream side.

The discussed analysis applies to a dam in structurally good condition. The field observations indicate some materials attrition, including surface deterioration, is occurring. Although this analysis indicates generally satisfactory stability under normal operating conditions, there is a lack of information regarding the condition of many of the structural elements of the facility and the uplift forces acting on the base. Therefore, further investigations are recommended. Evaluation of existing structural conditions should be based upon inspection of the dam sections and abutment structures with the reservoir drawn down. Evaluation of the structure should include the dam's interior to determine the condition of the underside of the

upstream face, the buttresses and the base. Because of the influence on the dam's stability under flood conditions, means to evaluate the presence and magnitude of uplift acting on the base should be undertaken. This study should also investigate and evaluate the structural condition of the rock underlying the dam and immediately downstream for determining the resistance to displacement. Dam stability studies based on actually existing conditions should be performed and if necessary, recommendations to improve the stability should be developed. Meanwhile, maintenance and repair should be provided for deteriorated areas to ensure that the presently existing stability is retained.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

The Phase I inspection of the Palmer Falls Dam on the Hudson River did not indicate conditions which constitute an immediate hazard to human life or property.

The hydrologic/hydraulic analysis establishes the spillway capacity as 23% of the Probable Maximum Flood (PMF). The dam will be overtopped by 20.6 feet and 8.1 feet by the PMF and 1/2 PMF respectively. However, in the opinion of the inspection team, failure of the dam during the 1/2 PMF would not significantly increase the downstream hazard from that which would occur just prior to dam failure. Therefore, the spillway is inadequate according to the Corps of Engineers screening criteria.

The following specific safety assessments are based on the phase I visual examination and analysis of hydrology and hydraulics and structural stability:

1. The structural stability indicates unsatisfactory stability against overturning according to the Recommended Guidelines for Safety Inspection of Dams for cases of the dam subject to forces possible during winter operation (including ice loading), the 1/2 PMF and the PMF conditions. Under each of these conditions the resultant of the forces acting on the dam is located outside the middle third of the base indicating that tensile stresses would develop in the dam section.

2. The visual inspection revealed minor deterioration of horizontal joints in the spillway when viewed through the water cresting the spillway.

3. The walkway through the dam is unsafe, thereby prohibiting inspection of the interior.

4. Leakage reputedly takes place through the concrete into the core of the dams.

b. Adequacy of Information

The information available is adequate for this Phase 1 inspection report.

c. Urgency

During the inspections of the Palmer Falls Dam, water cresting the flashboards obscured the surface of the concrete spillway from view. The unsafe condition of the walkway through the center of the dam

prevented an inspection of the interior of the structure. Structural defects may exist that were undetected during the inspection. Therefore, the investigations recommended below should be undertaken within 6 months and remedial work should be completed within two years.

d. Need for Additional Investigation

Additional investigations should be undertaken to fully evaluate the structural condition of the dam. These investigations should consist of a physical examination of the structure with the impoundment drawn down so as to provide a view of the spillway concrete and a detailed inspection of the interior of the dam to determine the structural condition of the concrete and the extent of any leakage through construction joints. The walkway through the interior of the dam should be repaired to allow the inspection of the interior of the dam. Investigations should also be undertaken to evaluate the presence and magnitude of uplift forces acting on the dam. This study should also include the investigation and evaluation of the structural condition of the rock underlying the dam and immediately downstream. Dam stability studies based on actual existing conditions should then be performed. If necessary, recommendations to improve the stability should be developed. Meanwhile, maintenance and repair should be provided for deteriorated areas to ensure that the present existing stability is retained.

7.2 RECOMMENDED MEASURES

The following steps should be undertaken:

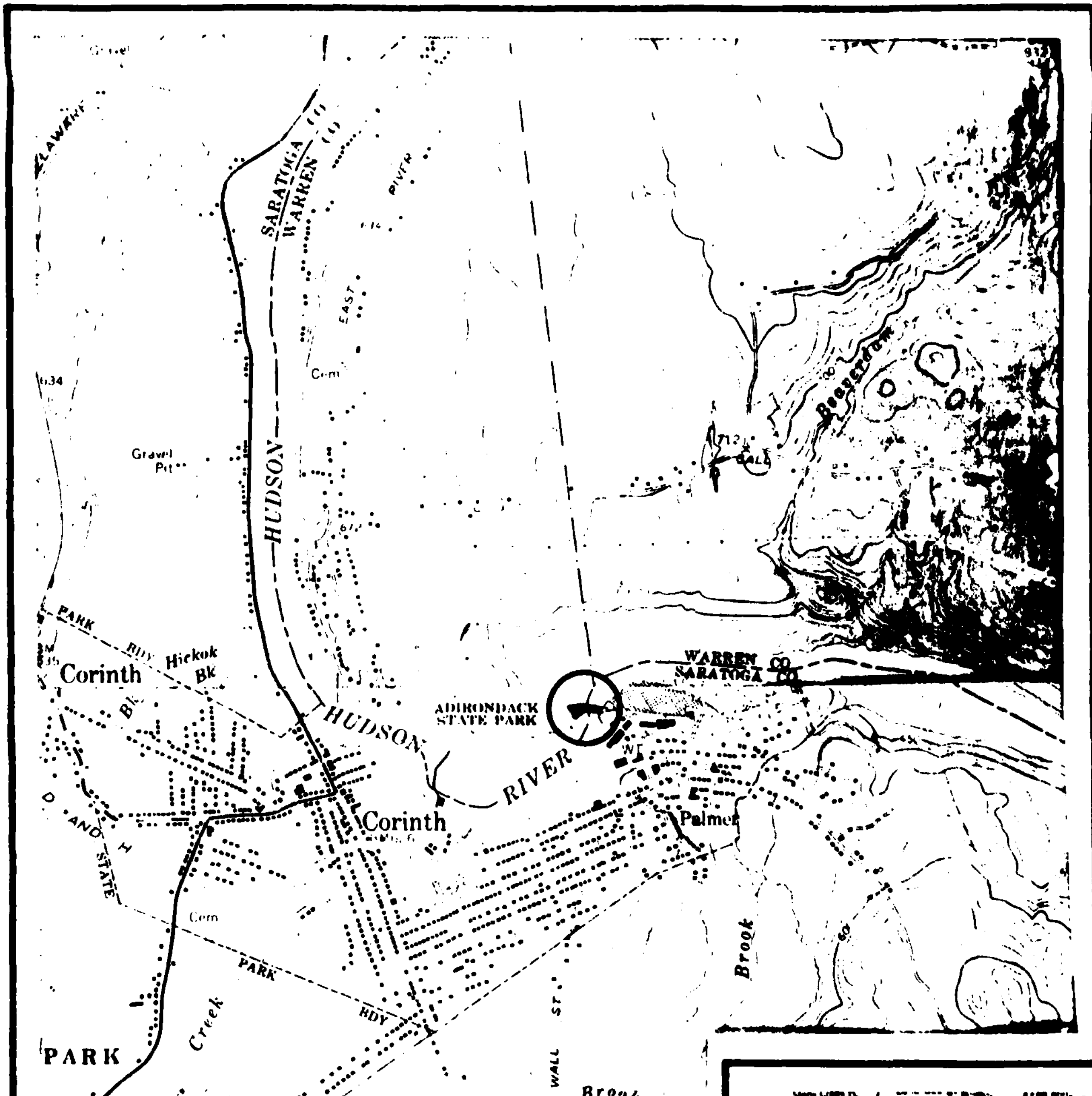
1. The walkway through the interior of the dam should be repaired within one year.

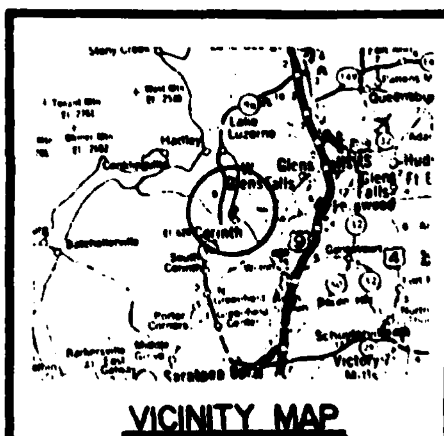
2. Complete the aforementioned structural inspections and structural stability investigations.

3. Undertake any repairs necessary as indicated by the detailed structural evaluations and stability computations.

4. A formalized inspection system should be initiated to develop data on conditions and maintenance operations at the facility.

5. A flood warning and emergency evacuation plan should be implemented to alert the public in the event conditions occur which could result in failure of the dam.





LOCATION PLAN

FIGURE 1

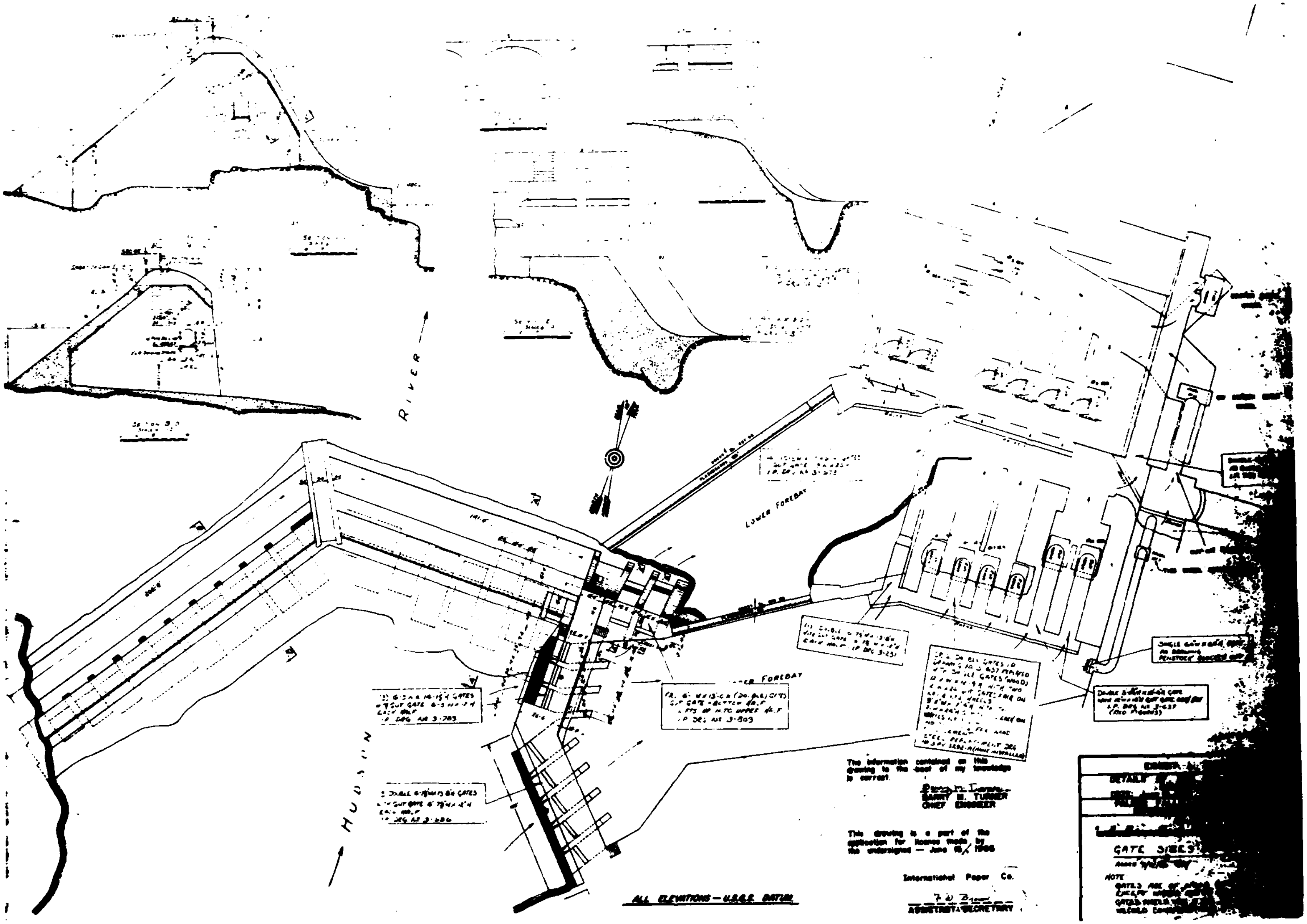

RIVER
HUDSON
LOWER FOREBAY
The information contained on this drawing to the best of my knowledge is correct.
CHIEF ENGINEER
International Paper Co.
ALL ELEVATIONS — U.S.G.S. DATUM
GATE SIDES

FIGURE 2

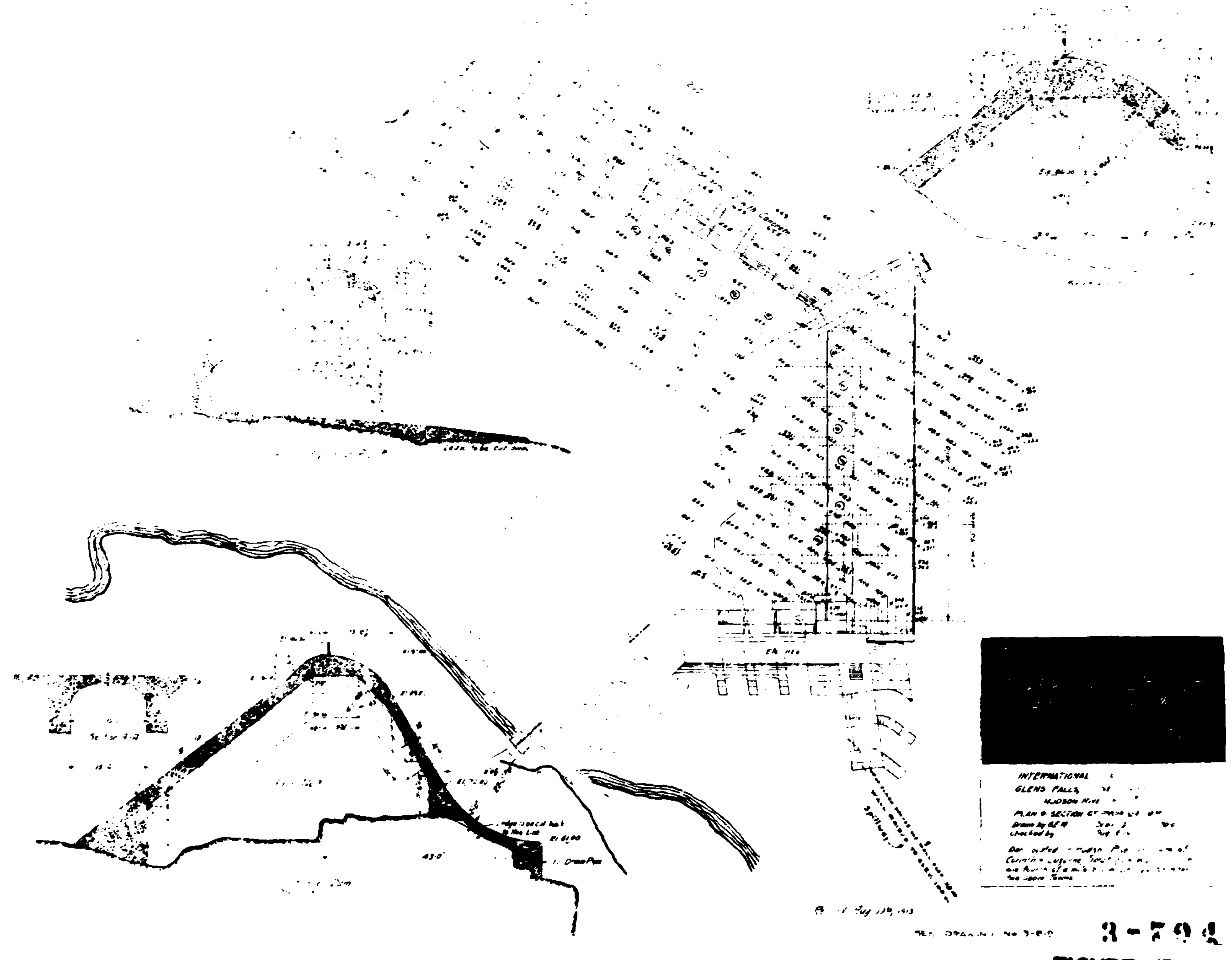
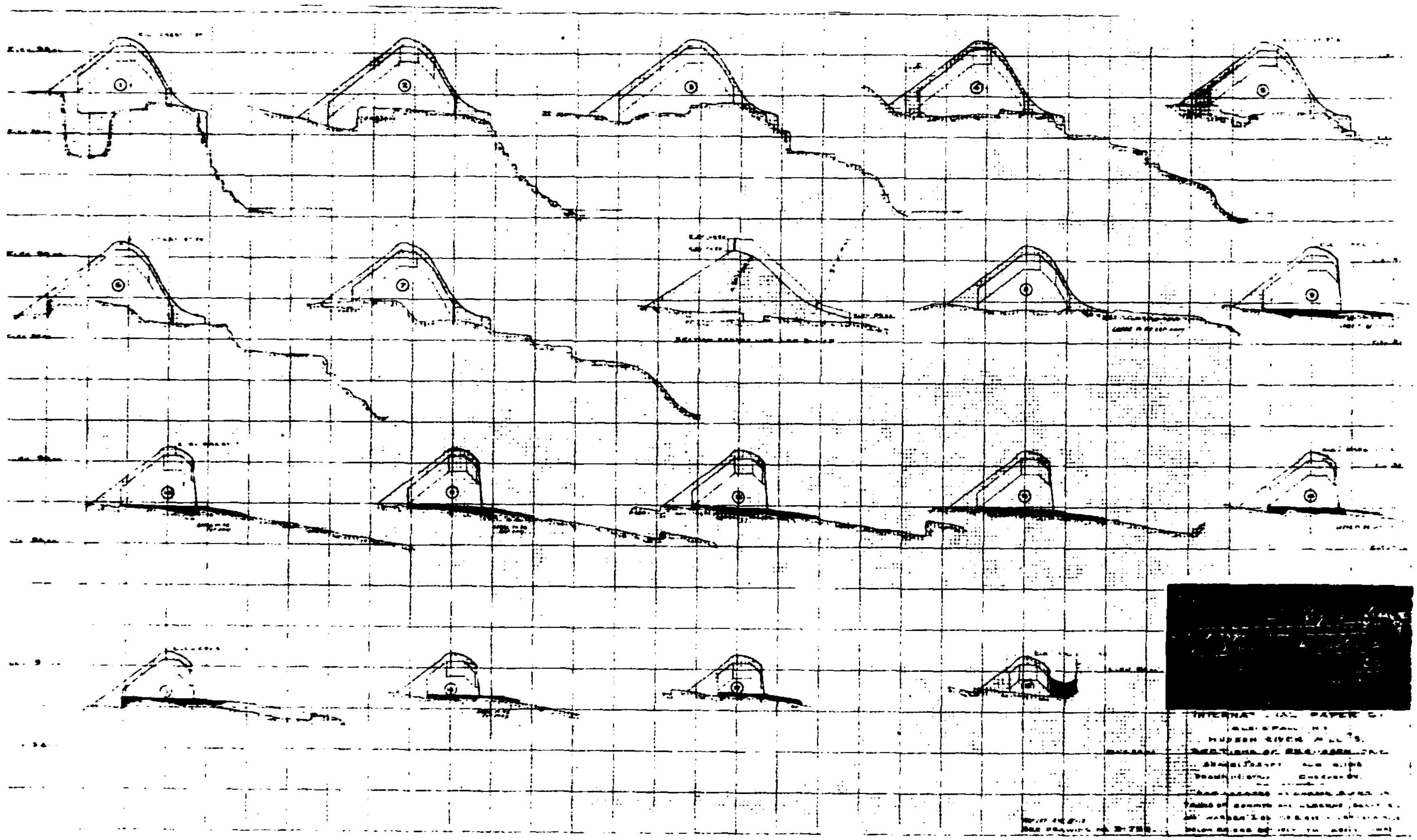


FIGURE 3



3 - 818

FIGURE 4

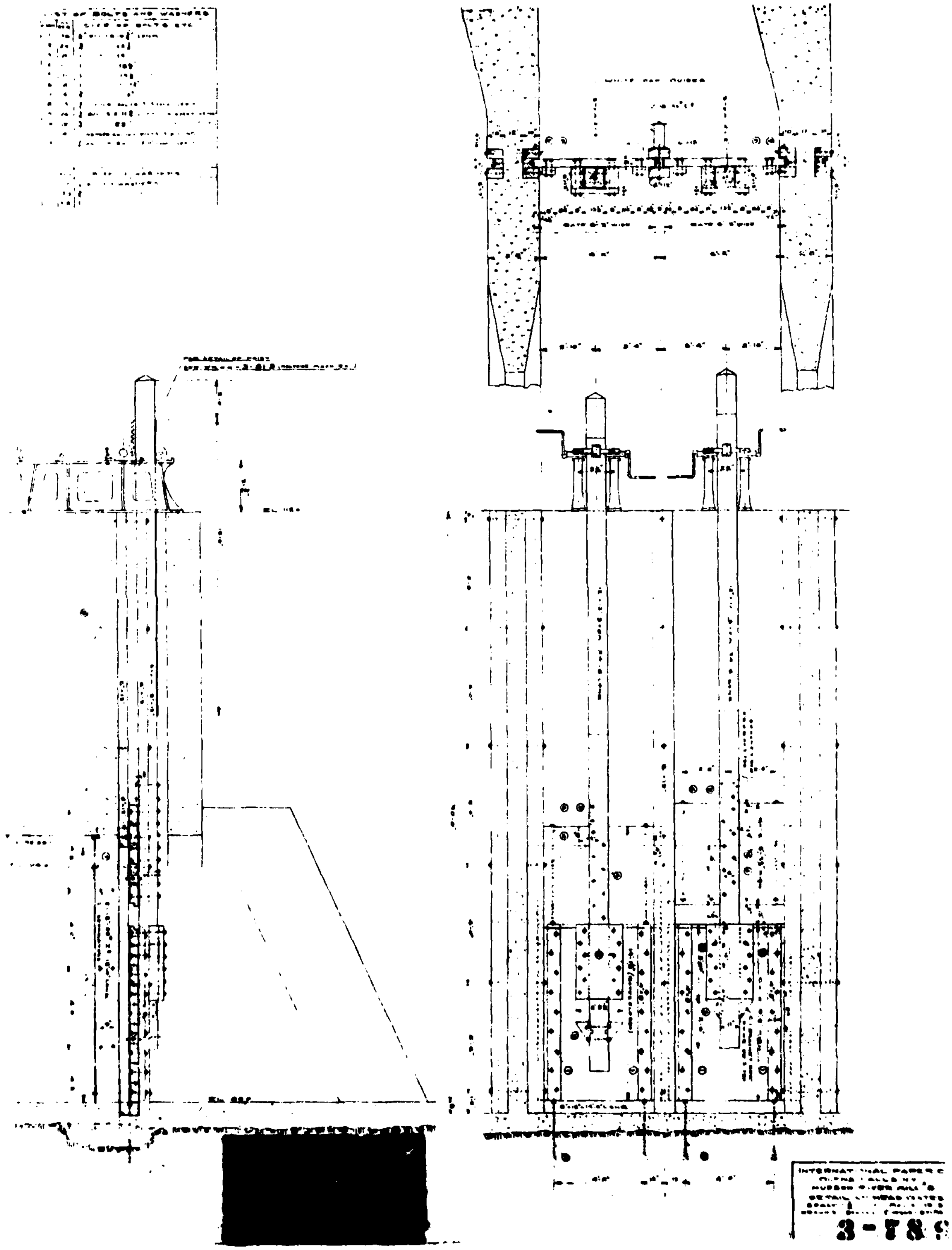


FIGURE 5

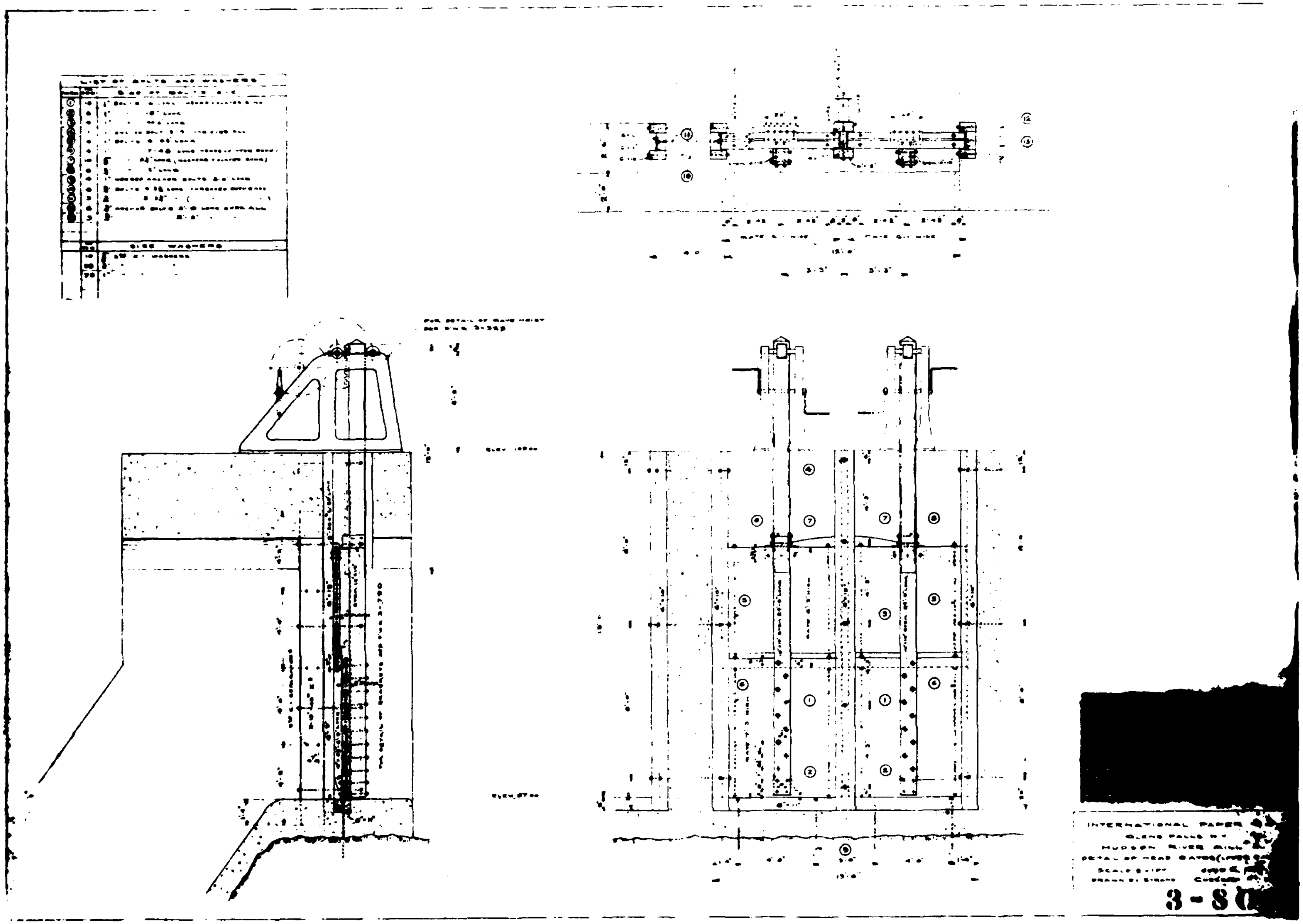
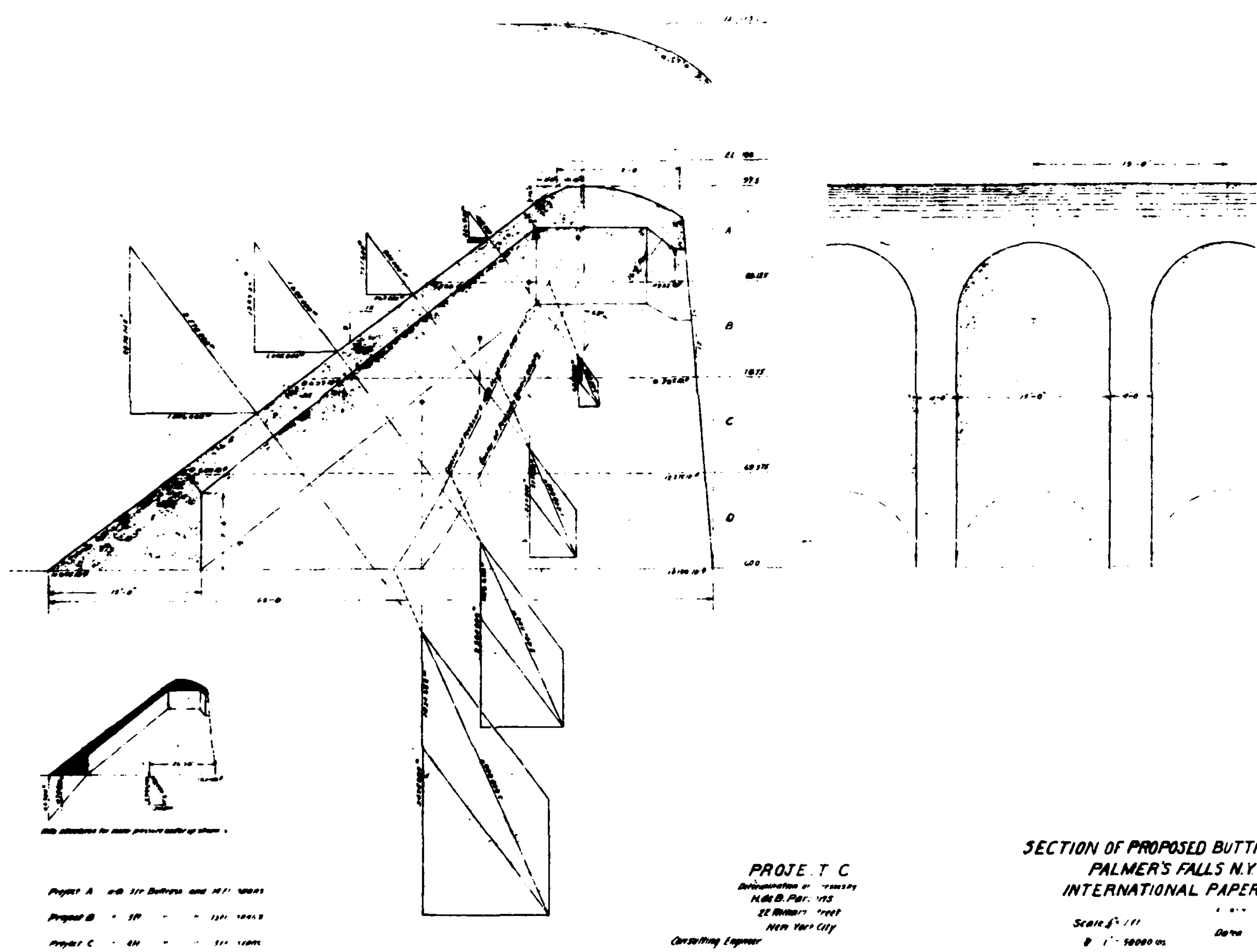


FIGURE 6



SECTION OF PROPOSED BUTTRESS DAM
PALMER'S FALLS N.Y.
INTERNATIONAL PAPER Co

FIGURE 7

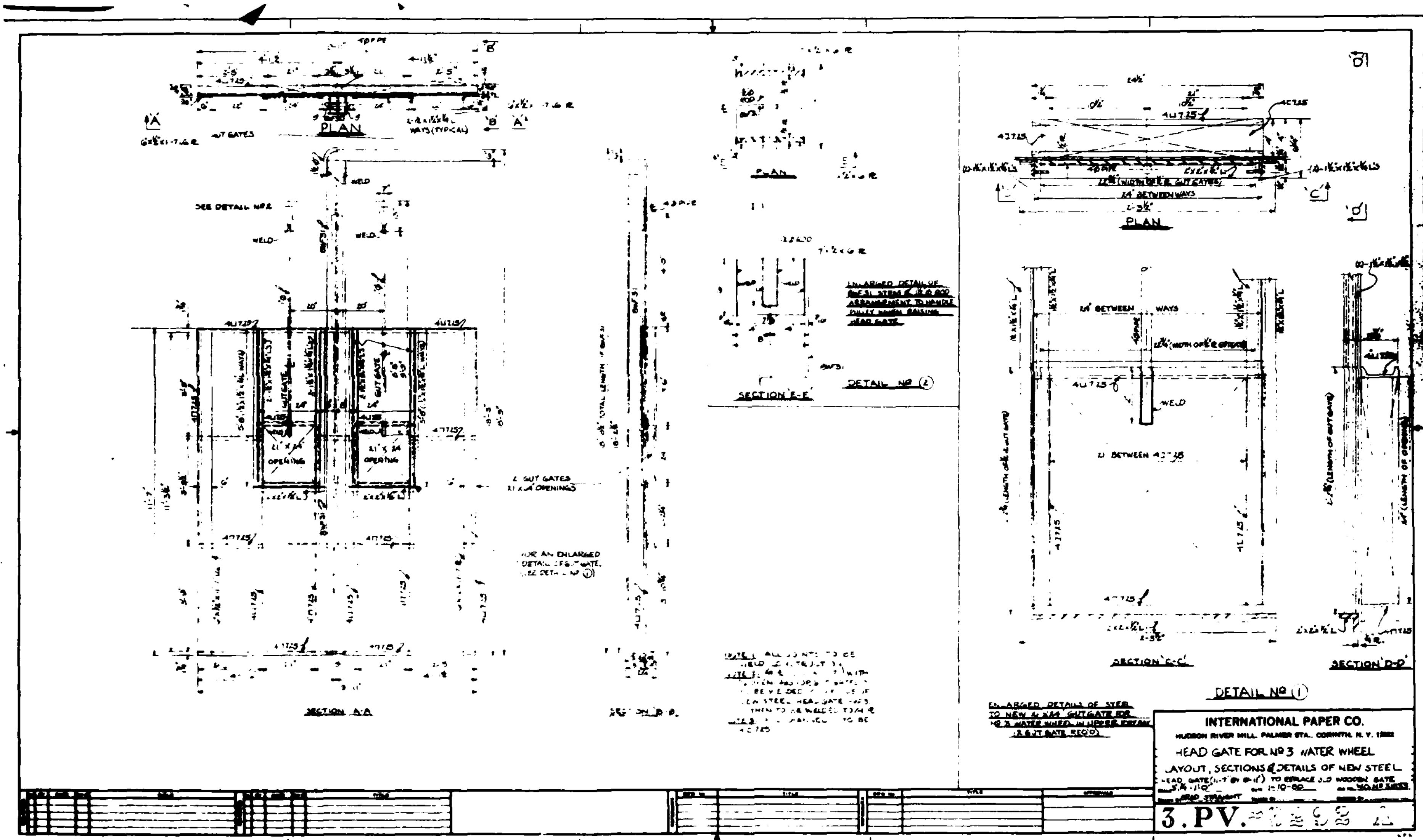

PLAN
SECTION A-A
SECTION E-E
DETAIL Nº 2
SECTION C-C
SECTION D-D
DETAIL Nº 1
24' BETWEEN WAYS
WELD
2 GUT GATES
OPENING
INTERNATIONAL PAPER CO.
HUDSON RIVER MILL, PALMER STA., CORINTH, N. Y.
HEAD GATE FOR Nº 3 WATER WHEEL
LAYOUT, SECTIONS & DETAILS OF NEW STEEL
3.PV.

FIGURE 8

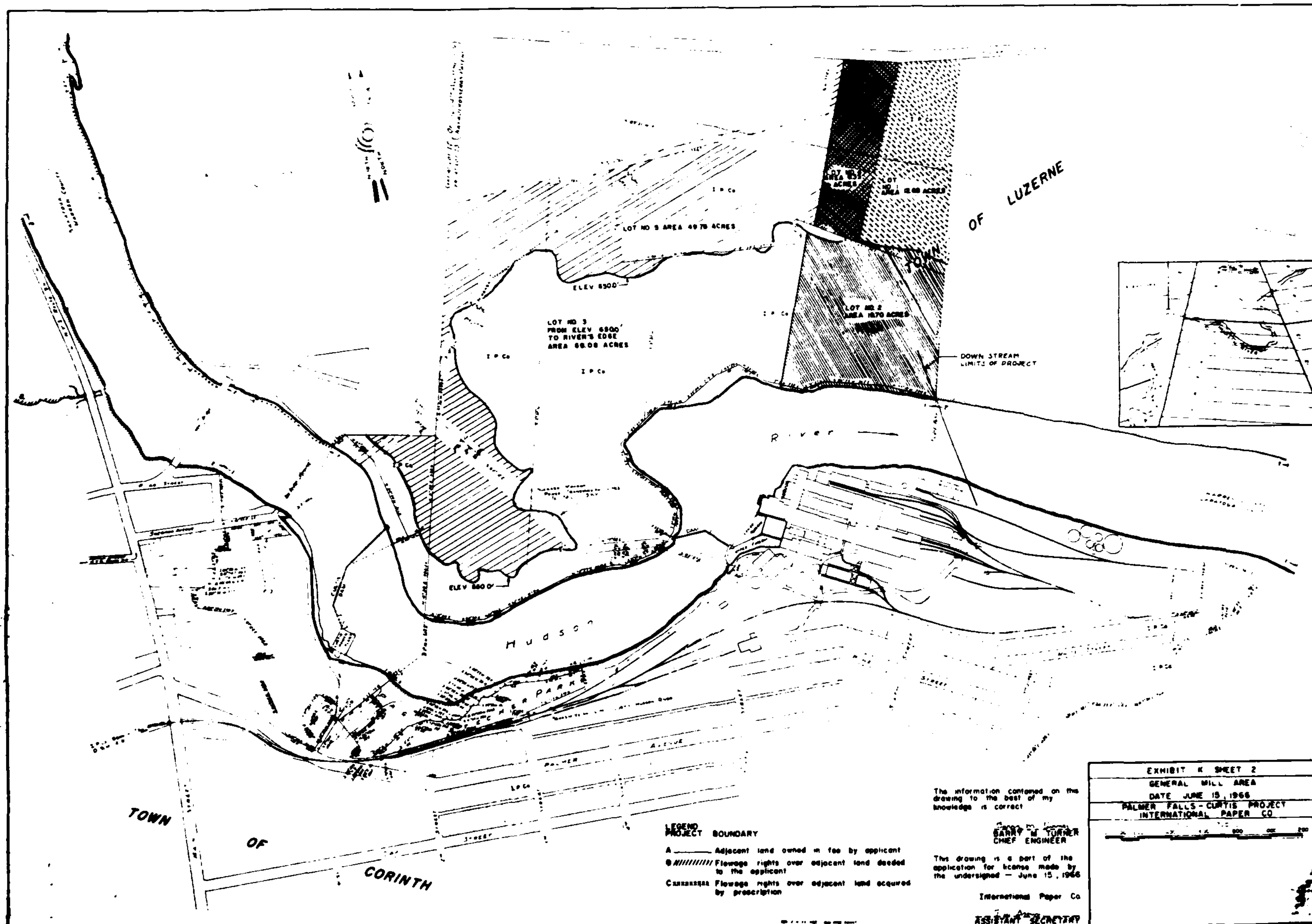

TOWN OF LUZERNE
TOWN OF CORINTH
Hudson River
LOT NO 5 AREA 49.78 ACRES
LOT NO 3
FROM ELEV 6500'
TO RIVER'S EDGE
AREA 66.08 ACRES
LOT NO 2
AREA 16.70 ACRES
ELEV 6500'
DOWN STREAM
LIMITS OF PROJECT
LEGEND
PROJECT BOUNDARY
A Adjacent land owned in fee by applicant
B Flowage rights over adjacent land deeded to the applicant
C Flowage rights over adjacent land acquired by prescription
The information contained on the drawing to the best of my knowledge is correct
BARRY M TURNER
CHIEF ENGINEER
This drawing is a part of the application for license made by the undersigned — June 15, 1966
International Paper Co
ASSISTANT SECRETARY
EXHIBIT K SHEET 2
GENERAL MILL AREA
DATE JUNE 15, 1966
PALMER FALLS-CURTIS PROJECT
INTERNATIONAL PAPER CO

FIGURE 9

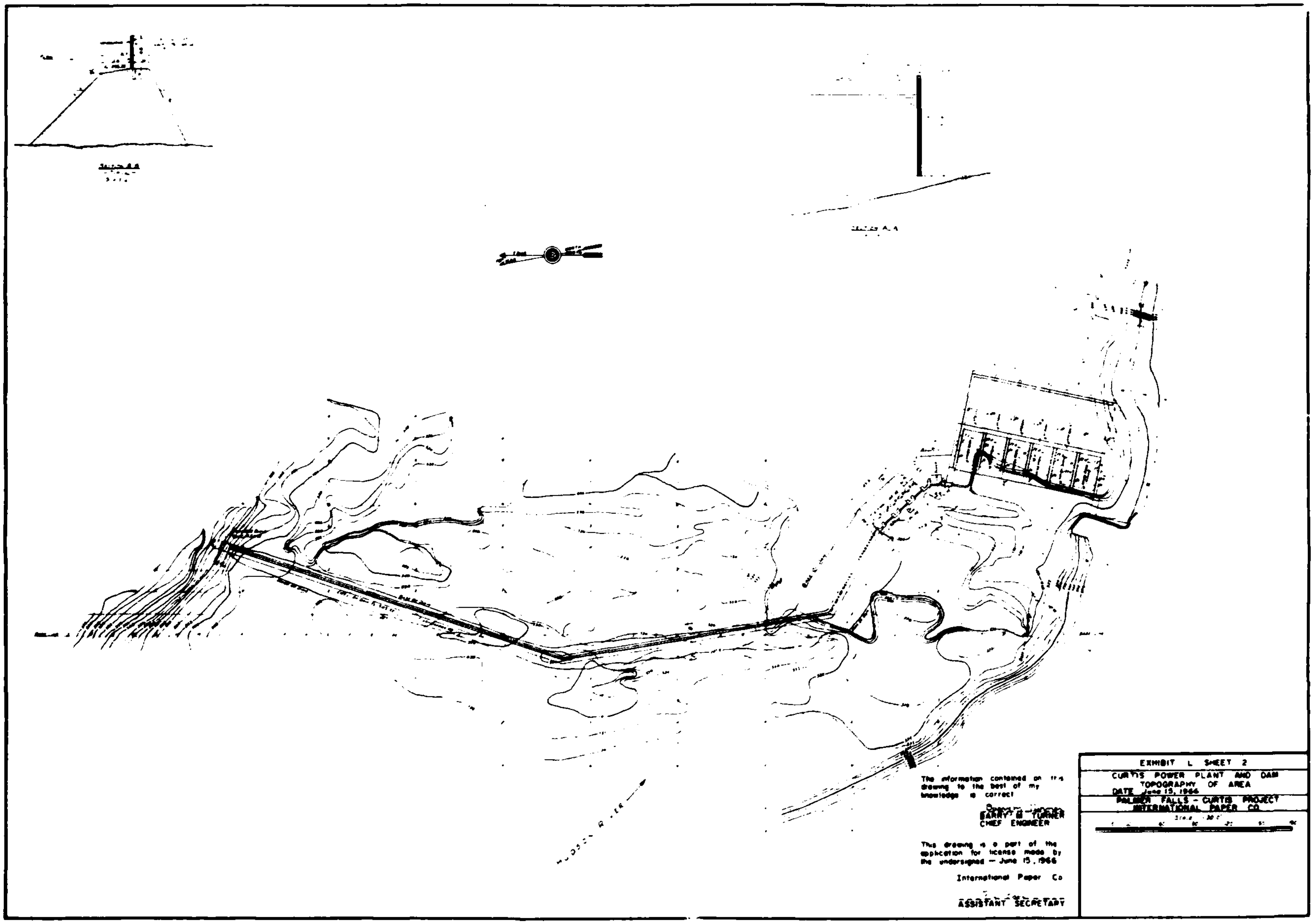
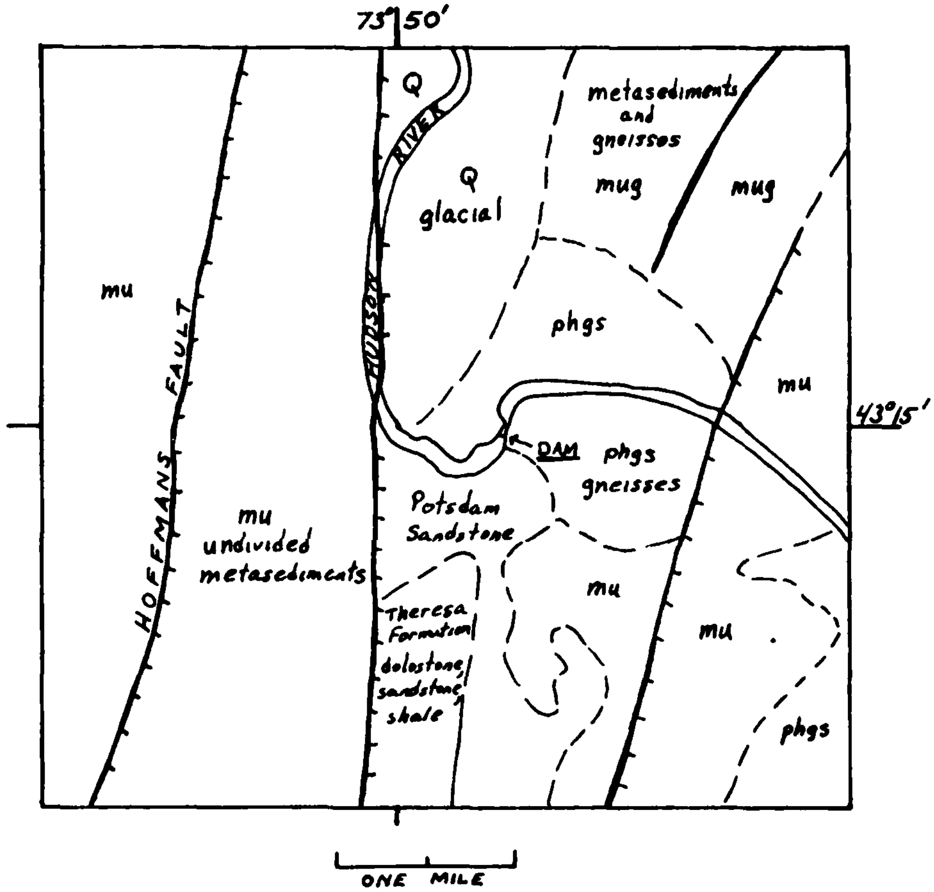

The information contained on this drawing to the best of my knowledge is correct
BARRY M TURNER
CHIEF ENGINEER
This drawing is a part of the application for license made by the undersigned — June 15, 1966
International Paper Co
ASSISTANT SECRETARY
EXHIBIT L SHEET 2
CURTIS POWER PLANT AND DAM
TOPOGRAPHY OF AREA
DATE June 15, 1966
PALMER FALLS - CURTIS PROJECT
INTERNATIONAL PAPER CO.

FIGURE 10



GEOLOGIC MAP

Fault, if normal hachures ondownthrown side

Rock type contact

STETSON • DALE

DATE	DRAWN	FIGURE 11
6-2-80		
JOB	APP'D	
2399		

APPENDIX A

FIELD INSPECTION REPORT

CHECK LIST
VISUAL INSPECTION

PHASE 1

Name Dam Palmer Falls **County** Saratoga-Warren **State** New York **ID #** NY145

Type of Dam Concrete Cellular **Hazard Category** High

Date(s) Inspection 1. April 21, 1980 / 2. May 18, 1980 **Weather** Sunny **Temperature** 60's

Pool Elevation at Time of Inspection 521.5+ M.S.L. **Tailwater at Time of Inspection** no measurement taken

Inspection Personnel:

1 & 2	F.W. Byszewski	Dale Engineering Company	
1 & 2	J.A. Gomez	Dale Engineering Company	
1	D.F. McCarthy	Dale Engineering Company	
1	H. Muskatt	Dale Engineering Company	
1	W. Lynick	New York State Department of Environmental Conservation, Dam Safety Sect	
1	R. Talbot	Supervisor of Engineering Services - International Paper Company	

J. Gomez **Recorder**

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	No seepage observed through concrete. Water flowing over spillway at time of inspection, obscuring face of spillway.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Abutments embedded in gneiss. No signs of distress observed at junctions.	
DRAINS	None observed.	
WATER PASSAGES	Conditions of flow did not permit close up inpection of water passages. Observations from a distance did not reveal defects.	
FOUNDATION	Dam sited on gneiss. Bedrock is very durable as evidenced by sharp edged geometry of rock just beyond toe.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Some deterioration observed (as viewed through flowing water) at a number of areas just below spillway crest (on southern portion). Some surface spalling (to 3-4 inches deep) on south abutment wall and walkway.	Reportedly some surface restoration work performed to dam in summer of 1979.
STRUCTURAL CRACKING	Some deterioration of log chute at point of "V", at one third height from top, etc.	Dam was not inspected from interior, due to walkway condition. Further investigations should include a thorough inspection of the interior of the dam.
VERTICAL & HORIZONTAL ALIGNMENT	No anomalies observed.	
MONOLITH JOINTS	No monolith joints observed in spillway section, possibly due to amount of overflow.	
CONSTRUCTION JOINTS	Location of horizontal joints observed through water flowing over spillway indicating some deterioration at joints.	
STAFF GAGE OF RECORDER	None observed.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Not applicable.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Not applicable.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Not applicable.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Not applicable.	
RIPRAP FAILURES	Not applicable.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Not applicable.	Dam extends to rock cliffs.
ANY NOTICEABLE SEEPAGE	Not applicable.	
STAFF GAGE AND RECORDER	Not applicable.	
DRAINS	Not applicable.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Some deterioration of concrete just below crest. Much of crest and downstream face was only observed from a distance.	Ambursen style dam. Sloping faces and rounded crest. North section - open D/S face, south section - closed downstream face.
APPROACH CHANNEL	Hudson River - side slopes - rock cliffs.	46 inch flashboards in use year round. Survived ice flows of past winter.
DISCHARGE CHANNEL	Hudson River - bedrock (gneiss), very durable.	
BRIDGE AND PIERS	Log chute at middle of "V" shows some deterioration.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT		8 gut gates pass water into upper forebay. Upper fore-bay either discharges through mill or into lower forebay through 2 low level gut gates.
INTAKE STRUCTURE	Upper forebay walls show some surface deterioration.	outlets or flow over flash-boards on upper forebay dam. Some of mill water discharges into lower forebay, while some mill operations utilize full head of dam & falls.
OUTLET STRUCTURE		Some of lower forbay water passes through mill, while excess is wasted over lower forebay dam.
OUTLET CHANNEL	Natural stream channel.	
EMERGENCY GATE	Impoundment can be drawn down by gut gates outletting from upper forebay.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Rock & boulder bottom. No observed obstructions downstream.	
SLOPES	Steep just below dam (dam built on top of natural falls), fairly shallow slopes downstream of falls.	
APPROXIMATE NO. OF HOMES AND POPULATION	Mill on riverbank, immediately downstream. Recreational use of river - fishermen observed just downstream of dam on both visits, even with high flows.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	Not applicable.	
OBSERVATION WELLS	Not applicable.	
WEIRS	Not applicable.	
PIEZOMETERS	Not applicable.	
OTHER	Not applicable.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Side slopes - very steep; rock cliffs.	
SEDIMENTATION	Not observable.	

NAME OF DAM Palmer Falls Dam

ID # NY 145

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE 1

ITEM	REMARKS
AS-BUILT DRAWINGS	1966 drawings.
REGIONAL VICINITY MAP	U.S.G.S. map, 1966 plans.
CONSTRUCTION HISTORY	As derived from correspondence contained in N.Y.S. D.E.C Dam Safety files.
TYPICAL SECTIONS OF DAM	1913, 1966 plans.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	1966, 1980 plans, details.
RAINFALL/RESERVOIR RECORDS	None known.

ITEM	REMARKS
DESIGN REPORTS	1913 Report.
GEOLOGY REPORTS	Some information in 1913 Report.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	1913 Report, although some calculations apply to original design not current configuration.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	1913 correspondence.
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	None applicable.

ITEM	REMARKS
MONITORING SYSTEMS	None known.
MODIFICATIONS	Original design appears to have been modified during construction. Southern portion appears to have been moved upstream somewhat.
HIGH POOL RECORDS	Unknown. During spring high water, water level about to top of downstream training wall.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None known.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Correspondence.
MAINTENANCE OPERATION: RECORDS	None Known.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	1966 plans.
OPERATING EQUIPMENT PLANS & DETAILS	1966, 1980 plans & details.

CHECK LIST
HYDROLOGIC & HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Upper Hudson, 2757 sq. mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 358 ac.-ft. @ elev. 5209

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 561 ac.-ft. @ elev. 531.7

ELEVATION MAXIMUM DESIGN POOL: 16 ft. above crest of spillway

ELEVATION TOP DAM: 531.7

CREST:

a. Elevation 517.17 (spillway), 520.92 (Flashboards`
b. Type Ambursen
c. Width Ogee Shape
d. Length 346 ft.
e. Location Spillover nearly entire length of dam
f. Number and Type of Gates None

OUTLET WORKS:

a. Type Gut gates in upper forebay
b. Location Right abutment
c. Entrance Inverts Not shown on plans
d. Exit Inverts Not shown on plans
e. Emergency Draindown Facilities Gut gates

HYDROMETEOROLOGICAL GAGES:

a. Type None
b. Location --
c. Records --

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

APPENDIX B

PREVIOUS INSPECTION REPORTS/RELEVANT CORRESPONDENCE

GEORGE E. VAN KENNEN, CHAIRMAN
JOHN D. MOORE, COMMISSIONERS
ALBERT E. HOYT, SECRETARY
JOHN J. FARRELL, ASST. SECRETARY

STATE OF NEW YORK
CONSERVATION COMMISSION
ALBANY

DIVISION OF INLAND WATERS
JOHN D. MOORE, COMMISSIONER
JAMES J. FOX, DEPUTY COMMISSIONER
RICHARD W. SHERMAN, CHIEF ENGINEER
ALEX. RICE McKIM, INSPECTOR OF DOCKS AND DAMS

FILE
RECEIVED
July 23, 1913
DIVISION INLAND WATERS
Chief Engineer

IN REPLYING PLEASE REFER TO FILE NUMBER
ANSWERED
McKim

July 23, 1913.

Mr. R. W. Sherman, Chief Engineer,

Conservation Commission,

Albany, N. Y.

Dear Sir:-

In accordance with your verbal instructions of the 16th inst., I visited Palmer Falls on July 19th and made an inspection of the dam now under construction by the International Paper Co.

Forms were being built for piers Nos. 3, 4, 5, 6 and 7 (as shown on plans submitted), and it was the intention of the Company to complete the concreting of these piers during the present week. Foundation trenches for piers 3 and 4 have been excavated from five to eight feet below the natural surface of the rock, and pairs of two inch round iron dowels extending five feet into the rock and from two to five feet into the masonry have been set, three feet center to center, the whole length of the piers. Shallower trenches set with dowels have been excavated for piers 5 and 6. In pier #7 (at the angle in the dam) about 30 dowels have been set, but no trench has been excavated. At this point the bedding plane of the rock ledge dips down stream about 10 degrees. From pier #7 to the west end of the dam, (piers 8 to 18), no trenches have been excavated, and only a single row of dowels, three feet center to

center, is being set in each pier.

Mr. Kellogg, engineer for the International Paper Company, to whom I was referred, was informed that they would be expected to conform to the "typical section" shown on their plans.

Attached hereto are six kodak pictures showing conditions on July 19th.

Respectfully yours,

E. S. Cullings

ESC/F

Assistant Civil Engineer.

[illegible]

[illegible]

CEMENT. All cement will be furnished by the Company. It shall be [illegible] in a dry place. [illegible] by the International Paper Company before leaving the cement works and will be tested as soon as practicable [illegible]. No cement from any one [illegible]

[illegible]

SAND. Sand shall be clean, coarse and of grains varying in size [illegible], free from all foreign matter. [illegible] shall be screened through a 1/4 inch mesh and all material larger than 1/4 inch in diameter shall be excluded from the sand. The material which is excluded may be used in place of stone, if so desired.

STONE. Stone shall be run of crusher. Crushed and screened from all [illegible] and very fine material. The stone shall be crushed so as to pass a 2-1/2 inch ring. Large stone may be imbedded in the concrete provided that these stones are sound, clean and thoroughly imbedded in concrete. No such stone shall be allowed within 6 inches of any form or of any similar stone already placed. Stone shall be laid so as to break joints and so as to help bond the wall.

WATER. Water shall be clean and reasonably clear.

CONCRETE. Concrete shall be mixed in the following proportions; all quantities are expressed in parts by volume:

Cement	1 Part
Sand	3 Parts
Stone	5 Parts
Water	27% weight of cement

Concrete may be mixed by machine or by hand, but machine mixed concrete shall be used wherever possible. For hand mixing a tight platform shall be provided of at least sufficient size to accommodate men and materials for the mixing of mortar and concrete at the same time. Batches shall not exceed one cubic yard each. In mixing, a mortar shall first be prepared by spreading the sand for one batch evenly upon the platform, then the cement upon the sand. These shall be mixed thoroughly dry until of an even color. Add all the water necessary to make a thin mortar and mix to a uniform consistency. The crushed stone for one batch is to be spread on the platform in a uniform layer not exceeding [illegible]

[illegible] until thoroughly [illegible]

[illegible] Engineer [illegible]

[illegible] shall be placed thoroughly [illegible] the form in order to obtain a good surface and tamped sufficiently to level off. Whenever possible, each layer is to be placed before the layer next below has set. When concrete is laid on concrete which has already set, the lower layer shall be left rough to insure bonding and shall be thoroughly cleaned of all "laitance" and scrubbed with coarse brushes and water before the next layer is placed upon it. In no case shall such a joint be made within 18 inches of the top of finished work. At such place as the Engineer may deem necessary tongues or grooves are to be formed in the concrete to insure the bonding of one part on another. No concrete shall be allowed to set in thin layers or edges. Concrete shall be placed immediately after mixing, and any concrete having an initial set before placing [illegible]

FORMS. Forms are to be built tight and of design and strength satisfactory to the Engineer, and are to be set and maintained true to line and grade. For all exposed work the [illegible] [illegible] and free from loose knots. Forms shall be built in such a way that the boarding is either horizontal or vertical. Where there are corners on the concrete liable to cause injury, suitable mouldings are to be placed in the angles of the form to round these corners. These mouldings shall be made from 2 inch stock and machine moulded so as to produce round corners on the concrete with approximately a 2 inch radius. Lumber once used in forms shall be thoroughly cleaned before being used again. Forms must not be removed within 60 hours after the completion of the work and then only by permission of the Engineer. All forms shall be thoroughly oiled before the concrete is placed against them.

FINISH. The top of all concrete work shall be finished smooth, true to line and grade at the time of laying the body of the work. After the forms are removed all small voids shall be neatly filled with mortar and the whole surface rubbed with carborundum bricks to produce a uniform surface and texture.

PREPARING FOUNDATIONS. All loose rock shall be moved from the foundation before the concrete is placed, and no concrete shall be placed where there is any running water which might wash the cement from the concrete. The ledge under each pier shall be thoroughly roughened so as to produce pockets and depressions which will prevent the piers from sliding out of position. In making these pockets or depressions no explosives shall be used which would tend to shatter the ledge beyond the limit of said pockets. In constructing the dam, the piers shall be built first, and the inclined top of the piers shall be constructed in steps so as to produce a satisfactory bond between the piers and arches. There shall be no horizontal joints extending over 20 feet in the length of the piers. In laying concrete in the arches the joints between concrete which has set and new concrete shall be perpendicular to the upper slope of the dam. The contractor will be required to place the reinforcing irons or rails to be used in the top portion of the dam as re-inforcement against ice pressure.

FORM 197 A.

FILE

Duplicate

REPORT ON

PROPOSED CONCRETE DAM,

HUDSON RIVER AT PALMER FALLS, N.Y.

H. DE B. PARSONS,
22 WILLIAM STREET,
NEW YORK.

REPORT ON

PROPOSED CONCRETE DAM,

HUDSON RIVER AT PALMER FALLS, N.Y.

H. DE B. PARSONS
CONSULTING ENGINEER
22 WILLIAM STREET, NEW YORK

REPORT ON PROPOSED CONCRETE DAM,

HUDSON RIVER AT PALMER FALLS, N. Y.

19th May, 1913.

International Paper Company,
30 Broad Street,
New York.

Gentlemen:-

Complying with the request of your President, Mr. Philip T. Dodge, and with more detailed instructions from your Chief Engineer, Mr. A. H. White, I beg leave to submit my opinion on a concrete buttress dam which you propose to erect at Palmer's Falls, N.Y.

I have made studies and calculations for the proposed dam and have visited the site at Palmer's Falls, on 30th April, in company with Mr. White.

The specific questions which were asked and my replies thereto are as below:-

1. How to make temporary repairs ?

A section of the present wooden crib dam was washed out during the March flood, and lack of water in the head race has resulted in closing the mill down, except for such power as

could be obtained from the neighborhood by electric [illegible]. It is evident that the old dam must be permanently [illegible] new dam constructed. In the cost of either alternative [illegible] from having the mill closed must be considered.

In order to permanently repair the break [illegible] present dam it would be necessary to divert the water from [illegible] during the whole process of reconstruction.

The present dam could be temporarily repaired [illegible] the water turned into the head race leaving the bed of the [illegible] dry below the present dam, for the construction of a new dam. [illegible] other words the present dam could be used as a coffer dam [illegible] new dam and the mill could be kept running during the time of [illegible] structing the new dam.

After carefully studying the proposition, I [illegible] that this latter arrangement would be the better for your [illegible] and I have no objections to,--but on the contrary approve [illegible] plan for diverting the water as arranged by Mr. White.

This plan consists of building a temporary [illegible] crib dam with openings, below the upper portion of the [illegible] Then, make a breach in the present dam, so that the water [illegible] through the openings of the temporary construction. Then, [illegible] the portion washed out by the flood. Then, close the openings [illegible] the temporary construction, thus permitting the river to [illegible] the head race of the mill, which would take all the flow [illegible] summer months.

2. Will the new dam pass as much water as the old dam ?

As judged by the gauging of the river over the crest of the Spiers Falls dam during the high water period of the March flood, the discharge of the river was about 89,000 to 90,000 cubic feet per second.

WATER PASSED BY PRESENT DAM. The length of crest of the present dam, according to surveys handed me by Mr. White, is 663.5 feet at an average elevation of 100.33 feet.

The present dam has 532 feet, which is practically parallel to the flow of the river.

Length of portion of dam nearly perpendicular to stream.	131.5 feet.
Length of dam parallel to stream 532 ft. Taking 0.8 of this portion as equivalent to a dam perpendicular to the stream.	425.6 "
Equivalent dam, perpendicular to stream	557.1 "

Owing to the peculiar shape of the crest of the present dam, the coefficient of discharge is probably not greater than 3.33. With this coefficient it would require a depth of water on the crest of 13.4 feet in order to pass 89,000 cubic feet per second.

WATER PASSED BY PROPOSED DAM. The elevation of the crest of the proposed dam is at 97.50, or 2.83 feet lower than the crest of the present dam.

The total length of the proposed dam is given on the surveys furnished me by Mr. White as 376 feet.

By suitably designing the crest in accordance with the Cornell experiments, it would be safe to assume that the coefficient would have a value of at least 4. If this value for the coefficient were used in the formula, the depth of water over the crest would be 15.4 feet in order to discharge 89,000 cubic feet per second.

Therefore,

The elevation of the water in the pond would be,

Above present dam	100.33 + 13.4	=	113.74 ft.
Above new dam	97.50 + 15.4	=	112.90 ft.

In other words, the river could be backed up by the new dam to a height of over 16 feet above its crest, without affecting the water rights at the Curtis dam any more than they would be affected by the present dam.

At time of severe flood, water could be passed into the lower level of the mill, and allowed to spill over its overfall section. Water so passed would be in addition to that discharged over the crest.

All my calculations have been based on a height of water of 16 feet above the crest, at which elevation the new dam will pass as much or more water as the present dam.

<u>3. What is the strength of the proposed buttress dam ?</u>

During my visit to Palmer's Falls I carefully inspected the rock formation, as the stability of the new structure depends on its rock foundation and the power of the rock to resist the abrasive action of the water. This abrasive action will be very

severe, owing to the great depth of water which will pass the crest at times of flood and the height of the fall which has a maximum of about 37.5 feet.

The rock appears to be a gneiss, as found throughout the Adirondack regions. It is very hard and compact, although somewhat easily broken owing to its planes of cleavage.

The rock lies in layers or strata, on a slight dip to the westward. These layers are of variable thickness. The rock is cut by a double system of vertical seams, oblique to one another.

The rock near the surface on the high banks at the gorge is much softer than the rock found in the bed of the river. Where the water has poured over the present dam for some thirty years, the edges of the rock at the various seams are not badly worn, but in many cases are sharp and angular. The same is also true for other edges of the rock exposed to the full flow of the stream, which is very rapid at this point.

Palmer Falls is a natural fall or rapids, and the rock has withstood the abrasive action for many generations without showing material wear after the softer surface rock had been cut away.

I am led to believe that the rock is amply strong for the foundation of the new dam, and owing to the vertical seams and joints which might be difficult to make tight, I favor the project, as proposed by Mr. White, of constructing a dam on the buttress principle. This type of dam has two advantages for a dam at Palmer Falls; First:- the weight of the water on the dam helps to increase

its stability, and Second:- if a leak should occur in the rock beneath the dam, there would be no tendency for uplift or overturning.

In order that the proposed dam shall have a reasonably long spillway, it seems necessary to give it the angular form, as proposed by Mr. White. I do not like this form, on account of the re-entrant angle where the two portions meet at midstream. I have given a great deal of study to try and avoid this apparent defect, but have not succeeded in securing a better general plan than that proposed, so long as the dam must be placed below the present dam.

I have made a number of calculations, which can be consolidated into three projects:

Project A. Buttresses 5 feet wide, spans 14 feet.
Project B. Buttresses 5 feet wide, spans 15 feet.
Project C. Buttresses 4 feet wide, spans 15 feet.

The object of using a span of 15 feet was suggested by Mr. White in order that the centers made for the dam at Cadyville could be used at Palmer Falls. In this I concur, as it would reduce the cost without impairing the strength of the dam.

I favor Project C and append to this report a design of the cross-section of the dam as proposed, and also a set of calculations showing the stability, masonry pressures, water pressures, etc.

GENERAL REMARKS.

Buttresses 4 feet wide would be amply strong and would permit a certain amount of loss through abrasion without endangering the strength of the dam.

I would recommend, however, that provision be made to protect the down-stream face of the dam on the portion from the re-entrant angle to the opposite bank from the mill, as owing to the rock formation the discharge water will have a tendency to flow somewhat parallel to the crest of the dam, especially at that portion near the bank.

Great care should be made at the re-entrant angle and at both ends of the dam, in order to secure sufficiently strong abutments to resist the horizontal pressures which will be transmitted.

I recommend having openings in the buttresses so as to aerate the spaces between and prevent the formation of a partial vacuum which would only add to the pressures.

I am in accord with the effort being made to widen the head race, as this will economize head of water, valuable at dry seasons.

If a water pressure should exist beneath the heel or upstream toe of the dam, the effect would be to change the point where the resultant cuts the base to a point further down stream. Even if maximum uplift pressures are considered beneath the heel,

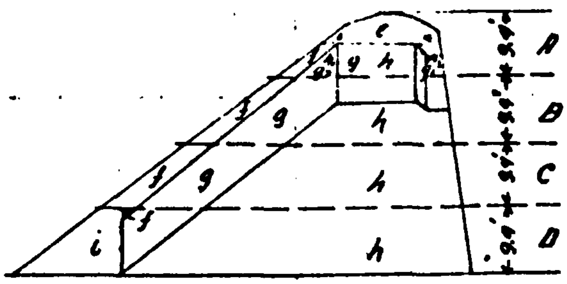
the resultant will still pass well within the middle third of the dam. Owing to the character of the rock it is not possible, in my opinion, for a complete uplift pressure to exist.

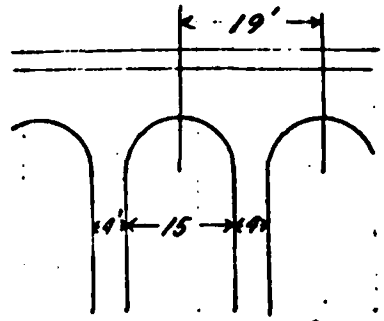
Yours respectfully,

H. A. B. Parsons

DUPLICATE.

International Paper Co.
Proposed Dam at Palmer's Falls N.Y.
Project C
Weight of 19' Section of dam





Concrete at 135# per Cu. ft.

			Cu. ft.	Weight	
Section "A"					
e	by Planimeter 3.12□" = 3.12□" scale × 16 × 19'	=	949	128 000	
e_1	$\frac{3.5+1}{2}$ × 2.1 × 19'	=	89.8	12 120	
f	9 × 19 × 2.1	=	359.0	48 500	
g	24.1 × 10.6'	=	255.0	34 400	
g_1	24.1 × 3.0'	=	72.0	9 740	
g_2	20.16 × 5.5'	=	118.0	15 930	
h_1	$\frac{6.75}{2}$ × 5.4 × 4'	=	72.9	10 000	
h_2	$\frac{2+5.5}{2}$ × 4 × 4'	=	60.0	8 108	
	[illegible] × 5.4 × 4'	=	232.0	31 360	298 158
Section "B"					
f	[illegible] × 2.5 × 19'	=	713.0	96 300	
g	20.16 × 15	=	302.0	40 800	
h_1	$\frac{12}{2}$ × 9.4 × 4'	=	225.5	30 450	
h	22 × 9.4 × 4'	=	827.0	111 700	279 250
Section "C"					
f	15 × 2.9 × 19'	=	827.0	111 700	
g	20.16 × 15	=	302.0	40 800	
h_1	$\frac{12}{2}$ × 9.4 × 4'	=	225.5	30 450	
h	34.75 × 9.4 × 4'	=	1306.0	176 300	359 250
Section "D"					
f	$\frac{2.5}{2}$ × 1.9 × 19'	=	45.1	6096	
g	20.16 × 7	=	141.0	19 030	
h_1	$\frac{7.5+19.5}{2}$ × 2.5 × 4'	=	85.0	11 470	
h	47.3 × 9.4 × 4'	=	1778	240 000	
i	$\frac{2.5+15}{2}$ × 9.4 × 19'	=	1563	211 000	487 595
					1 424 253

International Paper Co.

Proposed Dam at Palmers Falls N.Y.

Project C

Center of Gravity 19' Section

Section		Weight (1)	Length of Horizontal Lever Arm (2)	Product (1) and (2) (3)	Length of Vertical Lever Arm (4)	Product (1) and (4) (5)
"A"	e	128 000	11.2'	1 435 000	35.1'	4 495 000
	e_1	12 120	4.0	48 480	32.6	395 000
	f	48 500	22.0	1 067 000	31.0	1 503 000
	g	34 400	11.9	409 500	31.8	1 094 000
	g_1	9 740	4.6	44 750	30.0	292 200
	g_2	15 930	19.5	310 600	30.0	478 900
	h_1	10 000	19.4	194 000	29.8	298 000
	h_2	8 108	4.5	36 500	30.0	243 240
	h	31 360	11.8	370 000	29.7	931 000
		298 158		3 916 830		9 729 440

Center of Gravity Hor. = 3915830 / 298158 = 13.15' Vert. 9729440 / 298158 = 32.65'

Section		(1)	(2)	(3)	(4)	(5)
"B"	f	96 300	31.3	3 013 000	23.8	2 290 000
	g	40 800	27.6	1 126 000	23.4	955 000
	h_1	30 450	28.0	853 000	21.7	661 000
	h	111 700	12.8	1 430 000	23.5	2 626 000
		279 250		6 422 000		6 531 000

Center of Gravity A+B Hor = 10337830 / 577408 = 17.90' Vert. 16 260 440 / 577408 = 28.2'

Section		(1)	(2)	(3)	(4)	(5)
"C"	f	111 700	43.7	4 880 000	14.4	1 609 000
	g	40 800	39.6	1 615 000	14.0	571 000
	h_1	30 450	39.6	1 206 000	12.5	381 000
	h	176 300	18.5	3 262 000	14.1	2 488 000
		359 250		10 963 000		5 049 000

Center of Gravity A+B+C Hor = 21300830 / 936658 = 22.73' Vert. 21309440 / 936668 = 22.78'

Section		(1)	(2)	(3)	(4)	(5)
"D"	f	6 095	49.1	299 200	8.8	53 610
	g	19 030	47.7	908 200	7.6	144 600
	h_1	11 470	48.7	558 200	4.1	47 000
	h	240 000	24.0	5 760 000	4.6	1 104 000
	i	211 000	55.1	11 630 000	3.6	760 000
		487 595		19 155 600		2 108 210

Center of Gravity A+B+C+D Hor = 40456430 / 1424253 = 28.4' Vert. 23 417 650 / 1424253 = 16.4'

International Paper Co.
Proposed Dam at Palmer's Falls N.Y.
Project C
Water Pressure

Section "A"

$P = \frac{1}{2} wH(H+2h)$

$P = \frac{1}{2} \times 62.5 \times 9.38(9.38+32)$

$P =$ 12120# horizontal

For 19' section $P = 12120 \times 19 =$ 230 300#

Height above base where this pressure is applied is

$x = \frac{H+3h}{H+2h} \cdot \frac{1}{3} H$

$x = \frac{9.38+48}{9.38+32} \cdot \frac{1}{3} \times 9.38$

$x = \frac{57.38}{41.38} \times \frac{1}{3} \times 9.38 =$ 4.34'

Section "B"

$P = \frac{1}{2} \times 62.5 \times 18.75(18.75+32)$

$P =$ 29720# horizontal

For 19' Section $P = 29720 \times 19 =$ 565 000

$x = \frac{18.75+48}{18.75+32} \cdot \frac{1}{3} \times 18.75$

$x = \frac{66.75}{50.75} \times \frac{1}{3} \times 18.75$

$x =$ 8.23'

Section "C"

$P = \frac{1}{2} \times 62.5 \times 28.15(28.15+32)$

$P =$ 52900# horizontal

For 19' section $P = 52900 \times 19 =$ 1 005 000

$x = \frac{28.15+48}{28.15+32} \times \frac{1}{3} \times 28.15$

$x = \frac{76.15}{60.15} \times \frac{1}{3} \times 28.15$

$x =$ 11.90'

Section "D"

$P = \frac{1}{2} \times 62.5 \times 37.5(37.5+32)$

$P =$ 81400# horizontal

For 19' Section $P = 81400 \times 19'$ 1 546 000

$x = \frac{37.5+48}{37.5+32} \times \frac{1}{3} \times 37.5$

$x = \frac{85.5}{69.5} \times \frac{1}{3} \times 37.5$

$x =$ 15.4'

Proposed Dam at Farmers [illegible]

Project C

Sliding and Shear for each section of dam

Taking .65 as coef. of friction (concrete on concrete) = f

Resistance to sliding will be fW   W = weight

Section A	(Sliding) R = fW = .65 × 625 000 =	422 000	
	Horizontal water pressure =	230 300	
	Factor =		1.8
	(Shearing) Area of section 25.2 × 4 = 100.8 ◻		
	Resistance to shearing 100.8 × 14000 =	1 412 000	
	Horizontal water pressure =	230 300	
	Factor =		6.1
Section B	(Sliding) R = fW = .65 × 1 335 000 =	868 000	
	Horizontal water pressure =	565 000	
	Factor =		1.5
	(Shearing) Area of section 38.5 × 4 = 154.0 ◻		
	Resistance to shearing 154 × 14000 =	2 155 000	
	Horizontal water pressure =	565 000	
	Factor =		3.8
Section C	(Sliding) R = fW = .65 × 2 280 000 =	1 482 000	
	Horizontal water pressure =	1 005 000	
	Factor =		1.5
	(Shearing) Area of section 51.7 × 4 = 206.8 ◻		
	Resistance to shearing 206.8 × 14000 =	2 895 000	
	Horizontal water pressure =	1 005 000	
	Factor =		2.9
Section D	(Sliding) R = fW = .65 × 3 475000 =	2 258 000	
	Horizontal water pressure =	1 546 000	
	Factor =		1.5
	(Shearing) Area of section 65 × 4 = 260 ◻		
	Resistance to shearing 260 × 14000 =	3 640 000	
	Horizontal water pressure =	1 546 000	
	Factor =		2.4

Proposed Dam at Palmer's Falls N.Y.
Project C
Stability against Crushing
(Masonry Construction Baker page 472.

Max: Pressure per sq: ft = $P = \frac{W}{l} \pm \frac{6Wd}{l^2}$ — d = departure of C.G. of base from point of pressure

$P = \frac{W}{l}(1 \pm \frac{6d}{l})$

Section "A" $P = \frac{625000}{25.3} \left(1 \pm \frac{(x\,0.85)}{25.3}\right)$

$P = 24700 \quad (1 \pm .2015) = 24700 \times \begin{cases} 1.2015 \\ 0.7985 \end{cases}$

P = Up stream toe 29,680 or Down stream 19730 for 4' Buttress
∴ P = " " " 7420#6 " " 4932#4

Section "B" $P = \frac{1335000}{38.5} \left(1 \pm \frac{6 \times 0.05}{38.5}\right)$

$P = 34700 \quad (1 \pm 0.0078) = 34700 \times \begin{cases} 0.9922 \\ 1.0078 \end{cases}$

P = Up stream toe 34,410 or Down Stream 34900 for 4' Buttress
∴ P = " " " 8603#6 " " 8725#4

Section "C" $P = \frac{2280000}{51.7} \left(1 \pm \frac{6 \times 1.05}{51.7}\right)$

$P = 44100 \quad (1 \pm 0.122) = 44100 \times \begin{cases} 0.878 \\ 1.122 \end{cases}$

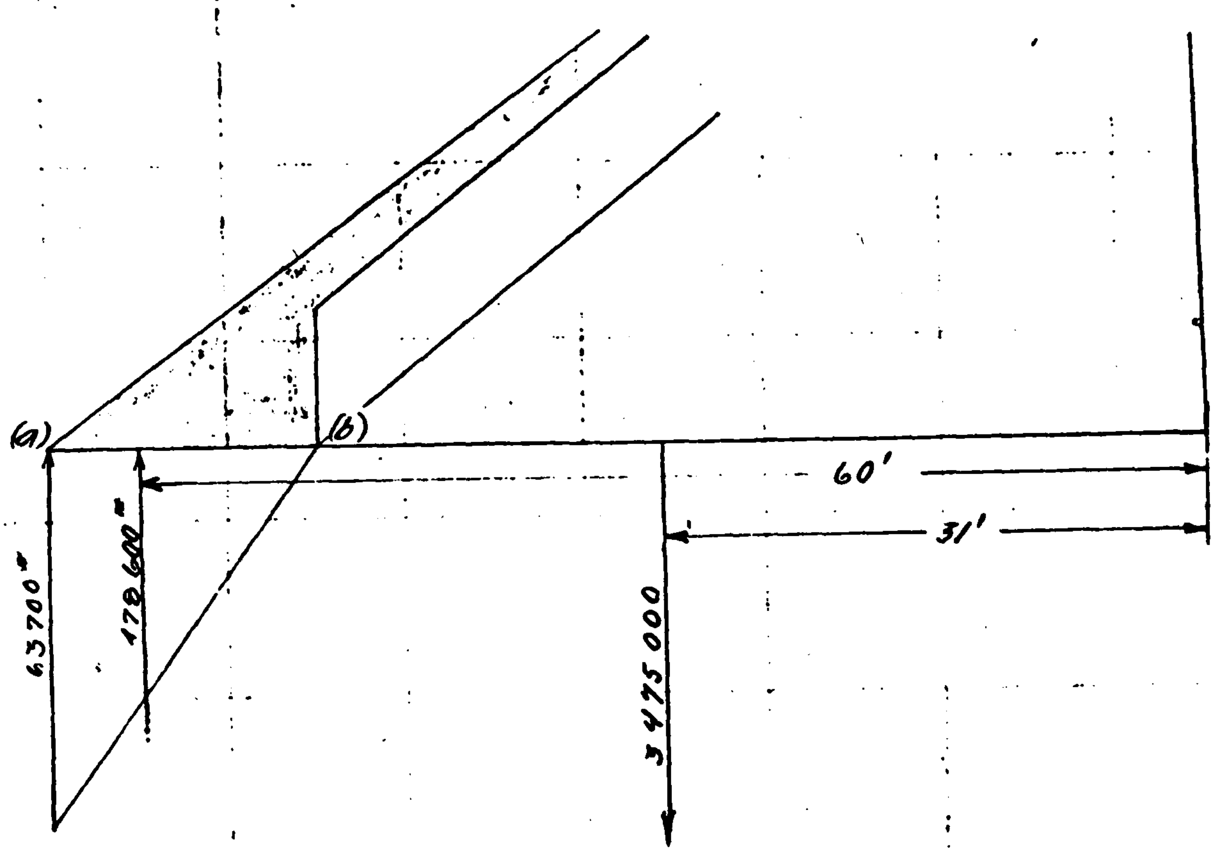
P = Upstream toe 38720 or Down stream 49100 for 4' Buttress
∴ P = " " " 9680#6 " " 12275#4

Section "D" $P = \frac{3475000}{65.0} \left(1 \pm \frac{6 \times 1.4}{65}\right)$

$P = 53500 \quad (1 \pm 0.1292) = 53500 \times \begin{cases} 0.8708 \\ 1.1292 \end{cases}$

P = Up stream toe 46580 or Down stream 60400 for 4' Buttress
∴ P = " " " 11,645#6 " " 15100#4

Proposed Dam at Farmers Falls N.H.
Project C
With allowance for water pressure under up stream toe



Hydrostatic pressure at up stream toe

62.5 × (37.5 + 16)	=	3 346 #⌀
Pressure for 19' length at toe	=	63 700 #⌀
Average pressure for 19' length (a) to (b)	=	31 900 #⌀
Total upward pressure 31 900 × 15	=	478 600 #

Taking moments about down stream toe

Left moment =	3 475 000 × 31	=	107 725 000
Right " =	478 600 × 60	=	28 716 000
	2 996 400		79 009 000

The distance Resultant will be from down stream toe is

$$\frac{790\,090\,00}{2\,996\,400} = 26.38'$$

Max: Pressures per sq: ft $= p = \frac{W}{l}\left(1 \pm \frac{6d}{l}\right) = \frac{2\,996\,400}{65}\left(1 \pm \frac{6 \times 6.12}{65}\right)$

$= 46{,}100\,(1 \pm 0.565) = 46\,100 \times \begin{cases} 0.435 \\ 1.565 \end{cases}$

P = Up stream toe = 20050 or Down stream toe 72 180 for 4' Buttress

P = " " " 5 010 " " " " 18 045 per ⌀

ORIGINAL

August 12th, 1913.

Mr. R. W. Sherman, Chief Engineer,

Conservation Commission.

Dear Sir:-

In accordance with your request, I submit the following report on the new dam under construction by the International Paper Company at Palmer Falls:-

This dam is being built to replace an old crib dam which was partially destroyed during the flood of March, 1913. As the paper mill is dependent almost entirely on water power, the Company decided to temporarily repair the crib dam, and to build a new masonry dam a short distance downstream, at the crest of the falls. In this way the crib dam could be used as a coffer dam, and the operation of the mill would not be interfered with during construction. The new dam is of the multiple arch type, built of concrete without reinforcement. It is V-shaped in plan and follows approximately the crest of falls.

The rock at this point is a granitic gneiss, hard and compact, but deeply cracked and fissured. The plane of chief fracture dips northerly from 10° to 15°, and a double system of cross fractures cuts the surface into blocks and plates of varying area and thickness. Light charges of dynamite exploded in shallow holes shattered this rock quite badly, and showed the existence of old cracks extending several feet into the apparently firm ledge. Immediately back of the heel of the proposed dam, a pocket or trench,

from 10 to 30 feet deep has been eroded along the line of a fault, nearly the whole length of the dam.

The stability of the proposed dam has been investigated, assuming a maximum surcharge of 18 feet on the crest. Following are the resulting stresses:-

Compression in deck masonry at center line of arch near base of dam - about	40# per sq.in.
Maximum compression in pier at toe	141" " " "
" " " " " heel	58" " " "
" shear in pier near base	54" " " "
Factor of safety against overturning	2½

All these are well within the limits of good practice. As to stability against sliding, however, the dam seems especially weak, the weakest point being pier #7, at the angle near the center of the dam. The rock surface at this point is smooth and waterworn, and has an average slope, downstream, of about 18 degrees. The forces acting on this pier have been calculated and the coefficient of friction between the masonry and rock surfaces is found to be 0.57. (See attached sheet, Acc. C-355). This is much too high for safety. The only precaution taken against sliding at this point is the placing of about 30 or 40 two inch iron rods set vertical and extending about five feet into the rock and from two to four feet into the masonry. These rods are probably of little value for this purpose.

Another element of danger is the possibility of the occurrence of a crack along the bedding plane of the rock at some distance below the base of the dam and extending from the trench back of the dam entirely through to the face of the falls. At the westerly end of the dam this distance would not be over 70 or 75 feet. Assuming

water pressure in such a joint equal to full static head at the back, decreasing uniformly to zero at the face, and acting over two-thirds the area, the coefficient of friction along this joint is found to be 0.69, as shown on attached sheet, Acc. No. C-356.

As no apron has been provided on this dam to divert the overfalling water away from the structure, there will be great danger of erosion at the bases of the piers. It would seem that some provision should be made to prevent this action.

I have inspected the site of this dam on three occasions. The first time, on July 19, 1913, I carried a letter of introduction addressed to "The International Paper Company," and on arriving at their office at Palmer Falls asked for the chief engineer. I was introduced to Mr. Kellogg, to whom I presented my letter of introduction, and stated the purpose of my visit. Mr. Kellogg introduced me to Mr. Ashworth, superintendent for the contractor building the dam, who showed me over a part of the work and then introduced me to Mr. Connor, (I believe that was his name), an inspector for the Company, who accompanied me during the rest of my stay on the work. At this time, forms had been built for piers Nos. 3, 4, 5, and 6, and work had been started on the forms for pier No. 7 (at the angle in the dam). No concrete had been placed in any of the piers at this time. Trenches five to eight feet deep had been excavated for piers Nos. 3 and 4, and somewhat shallower trenches for piers Nos. 5 and 6, but no excavation had been made for pier No. 7, and Mr. Connor stated that none was intended for this pier or for those to the west. Returning to the Company's office, I saw Mr. Kellogg and informed him that they would be expected to conform to the "typical section" shown

[illegible]

visit was on July 30, 1913, in company with Division Engineer Perkins. At this time the concreting of piers Nos. 3, 4, 5 and 6 had been completed, and about eight feet of concrete had been placed in pier No. 7. On August 8, I again visited the dam in company with Division Engineer Perkins and Assistant Engineers Cuter and Sargent. No concrete had been placed in pier No. 7 since July 30, [illegible] had been removed. Three or four piers to the east of this one had been completed, and forms had been built for two others near the westerly end of the dam. No work was in progress on August 8.

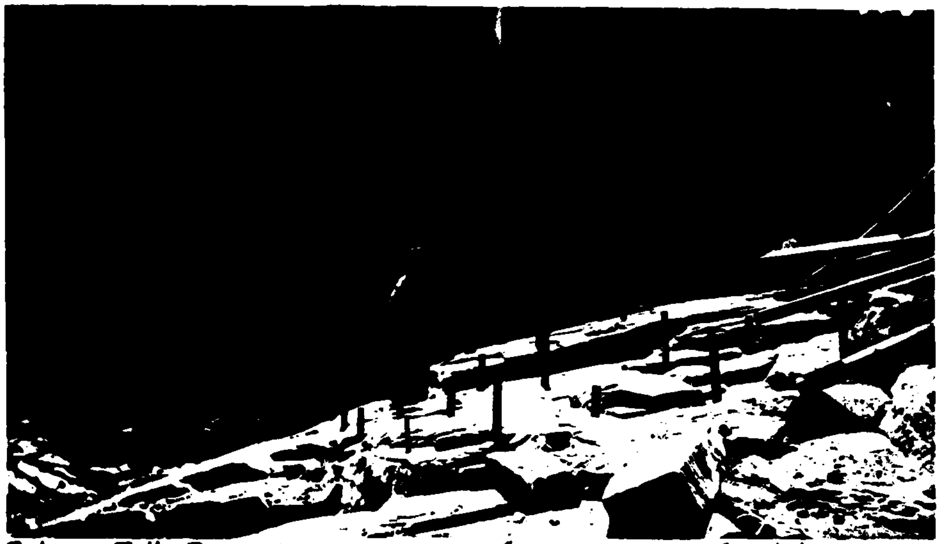
Attached hereto are photographs showing conditions on July 19 and August 8.

Respectfully submitted,

E. H. Cullings

Assistant Civil Engineer.

FSC/H.



Palmer Falls Dam - July 18, 1913 - Pier #7, showing slope of rock ledge

Palmer Falls Dam - July 19, 1913 - Showing Trench back of Dam


Palmer Falls Dam-Aug.8,1913-Trench back of Dam


Palmer Falls Dam- Aug. 8, 1913-Face of Piers.

Aug. 9, 1913.

Mr. E. W. Sherman, Chief Engineer,

Conservation Commission,

Albany, N. Y.

Dear Sir:-

In answer to your verbal request, I beg to submit the following report on the site of the dam proposed to be built by the International Paper Company at Palmer Falls.

In company with Division Engineer Perkins and Assistant Civil Engineer Suter and Cullings, I made an inspection of this dam site on August 8th. I made no technical examination of the plans, and it is assumed that the dam per se has been safely designed.

It is proposed by the International Paper Company to build a dam across the Hudson River, which is about 200 ft. wide at its narrowest point in this vicinity, immediately below their present dam, part of which was carried out by the floods of last spring. At the present time there is available a gross head of 83 ft. at the mill. The new dam is to be about 38 feet in height, and is to consist of eighteen concrete arches of 15 ft. span between concrete piers [illegible] ft. thick. Should a flood occur of the magnitude of that of last spring, there would be [illegible]

to have a total length of [illegible] feet.

The dam is situated on the crest of an abrupt falls approximately 20 feet high, giving a total fall of 60 ft. from the crest of the dam. About 40 ft. above the dam is a pocket 40 ft. long and 30 ft. deep at its deepest point; with 18 ft. of water on the crest of the dam it would give a total head of 88 feet, tending to uplift the foundation.

The foundation of the dam, which is a granite gneiss, is distinctly stratified and has a dip down-stream estimated at [illegible] degrees, and is fissured in several places both vertically and horizontally, the vertical cracks being the wider.

It would seem apparent that if the dam as proposed is to be constructed, the water with its clear fall of 60 ft. to 80 ft. would undermine the fissured rock at the base of the dam, thereby endangering the structure and making its eventual failure almost certain.

The pondage created by this dam would be small, and should the dam fail but little damage would probably result to the property below. It would not, however, seem advisable for the Conservation Commission to give its approval of the plans of a dam which seems liable to fail, even though the resulting damage might be slight.

In the writer's opinion, the best way to build a dam at this point would be to construct a concrete dam between the points where the new dam is being built, arching the dam upstream. A low secondary dam could be built a short distance below, creating a pool which would act as a water cushion for the flood flows over the main dam.

Without doubt, the [illegible] could be made safe by the construction of an apron, but probably at a prohibitive cost.

Respectfully submitted,

(Signed) Edward H. Sargent.

EHS/[illegible] Asst. Civil Eng.

August 13, 1913.

Report on Proposed Dam of the International Paper Co. at Palmer's Falls.

Mr. R. W. Sherman, Chief Engineer,

Conservation Commission.

Dear Sir:-

In accordance with your verbal directions I have examined the plans for the proposed dam of the International Paper Company at Palmer's Falls in the Village of Corinth, Saratoga County, and on August 8th I inspected the site of the proposed dam in company with Division Engineer Perkins and Assistant Engineers Sargent and Cullings.

The material on which the proposed dam is to be founded appears to be a hard gneiss. This rock is broken by cleavage and bedding planes into very distinct rectangular blocks of no great size and these planes of division appear to be continuous for long distances. The bedding planes are at an angle from 10 to 15 degrees with the horizontal, dipping down in the direction of the flow of the stream. A short distance back from the face of the falls there is a fault plane, practically vertical, which has been eroded to a depth of 30 to 40 feet and which is probably open to the entrance of water for a greater depth. The surface of the rock is not deeply water-worn, indicating erosion block by block rather than by surface abrasion of the rock mass. The natural fall at this point is between 37 and 60 feet.

The proposed dam is to be located practically on the crest of the existing fall. In plan it is to be L shaped with the angle pointing down stream, the shorter leg of the L crossing the line of the above mentioned fault at approximately right angles. The long side of the dam is to be placed upon the mass of rock lying between the fault plane and the face of the fall, which mass is structurally separated from the main rock body by the fault. The proposed dam is to be 44 feet high at the highest point. The maximum flood anticipated will give a depth of 18 feet upon the spillway crest.

The proposed type of dam has a deck inclined at an angle of 45 degrees. This is formed of plain concrete arches turned between buttresses placed normal to the axis of the dam; buttresses are triangular in side elevation. The crest is curved vertically with a wide radius. Details of the design of the dam proper have not been investigated by me, but consideration has been given to the possibility of sliding of the dam on its foundation, the sliding of the foundation itself and to the effect of erosion of the rock surface below the dam.

The dam, as shown by the plans and as partially constructed, rests upon a rock surface which slopes down in the direction of the water thrust. Some of the masonry has been laid upon undisturbed water-worn rock surface, which is very smooth. Where rock is excavated before placing masonry the surface of contact will be on natural bedding planes, which are as smooth as ordinary dressed masonry. Safe coefficients of friction on these surfaces would, in my opinion, be 35% and 45% respectively. I am informed by

Cullings that the stability of the proposed
sliding will not meet these requirements,
the salient angle, which is founded on a water-
face. Owing to the open design of the structure,
little chance for water pressure to develope in the
between masonry and rock. Where the open fault plane is
ck of the dam the effect of water pressure in
joints beneath the dam cannot prudently be neglected
the stability of this structure. Computations
for stability against sliding at the highest point
where it is upon the actual edge of the falls and
plane is practically at the heel of the apron.
the proposed dam rests upon a detached prism of
to carry it. Assuming water pressure
area the bedding joints, varying from full
the fault to nothing at the face of the falls,
that the resistance to sliding on the upper
than I consider desirable. I have not
, but I concur in Mr. Culling's theory.
dam to be stable as designed and to
foundation, there remains to be considered
water on the structure as a whole.
section, carrying water 18 feet deep
drop of as high as 44 feet on the
this falling water will strike
of the falls, where the rock is

[illegible] shattered and weather-worn. During times of flood this river will carry quantities of ice and logs. Under these conditions it seems inevitable that the rock immediately down stream from the dam will be shattered, broken off and carried away to an appreciable extent; that the lower extremities of the piers will be damaged and possibly undermined and this erosion will occur at the precise point where it will do the maximum amount of harm.

In my opinion a vertical drop on the down stream side of an overfall dam is always undesirable and should not be permitted in large structures. In general, such construction will not be safe unless the water falls clearly into a pool of considerable depth, or if the fall is so great as to break the falling water into spray before it reaches the bottom. That water will erode rock upon which it falls is a matter of common knowledge, and is clearly demonstrated at any water fall. That such erosion tends to extend horizontally at the point of impact is also well known. But for this undermining effect few actual cataracts or free falls would exist.

Such action at Palmer's Falls would undermine the buttresses, or cut out the lower corners of these structures. That such an action may be expected in this case is, to my mind, clearly demonstrated by comparison with the similar dam at Cadyville. There the loose upper strata of the rock on the north side of the dam were badly eroded by such action, while the drop and probably the volume of water passing were less than may be expected at Palmer's

Falls. This erosion endangered the stability of the structure. To make it safe much loose rock has been excavated from below the dam and the cavity being filled with concrete.

I respectfully recommend that: The plans for the proposed dam at Palmer's Falls, as submitted, be disapproved. That no modification or revision of these plans be approved, unless some form of reverse face for the dam is provided, which will carry the water gently down to the level of the base of the structure. It be required that no masonry be placed on the natural surface of the rock or on one that has been shattered by blasting. That where masonry is placed upon a properly excavated surface that the resistance to sliding come up to the specifications quoted above. The dam be so located as to be safe from the sliding of the dam on the foundation or of any portion of the foundation upon itself, on a natural joint, under the action of water pressure in that joint.

Respectfully submitted,

R. SUTER.

Assistant Civil Engineer.

RS/C.

Aug. 9, 1913.

Mr. E. W. Sherman, Chief Engineer,

Conservation Commission,

Albany, N. Y.

Dear Sir:-

Complying with your request for a report upon the proposed dam at Palmer Falls, I have visited the site four different times, and have examined the drawings and requested Mr. Cullings to figure out the stresses in the proposed structure.

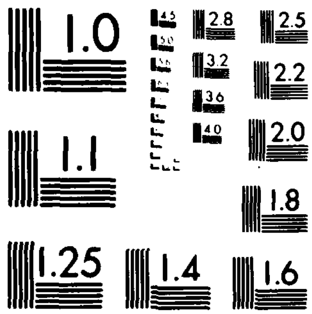
I may state as a result of these investigations in general that the design of the dam appears to be well within good engineering practice, provided it were to be placed upon a suitable foundation. The question of the safety of this dam, therefore, reduces itself to one of judgment as to the safety of the foundations under the conditions that would exist with the dam erected.

In the first place, it should be noted that the rock has well defined cleavage planes in two directions, at an angle of approximately 120 degrees. The cleavage planes most nearly horizontal dip at an angle of about 15 to 20 degrees down stream. Back of the proposed dam there is a fault in the rock, and the water has taken out the rock broken up by the faulting, leaving a deep hole along the edge of which the heel of the proposed dam

AD-A093 025 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/13
NATIONAL DAM SAFETY PROGRAM. PALMER FALLS DAM, UPPER HUDSON RIV--ETC(U)
AUG 80 J B STETSON DACW51-79-C-0001

UNCLASSIFIED NY-145 NL

2 of 3



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

would come over about three-fourths of the length of the dam. This line of faulting [illegible] location of the sluice gates and head gates. The dam is thus located upon a triangularly shaped mass of rock which, near its end near the sluice gates, is not over 30 ft. wide, and drops off to the lower pool of the river very steeply. These conditions might be described at greater length, and should be in case it is desired [illegible] proposed work.

The ~~[illegible]~~ runoff of the Hudson at this point may be expected to reach at times of maximum flood over 100,000 sec. ft., the discharge at Spier Falls having been over 90,000 sec. ft. during the last spring, and the drainage areas at the two points are but slightly different. This discharge would require a depth on the spillway of about 15 ft. This mass of water plunging from the top of the dam onto the shattered rock beneath would very probably take out everything in front of it, stripping off the rock layer by layer. The undermining action of this sheet of water falling through the height from the top of the dam to the level of the lower pool, which is 85 ft., cannot but result in further undermining the shattered rock. There is, therefore, great danger that in flood the portion of the dam resting upon the narrower part of the rock tongue would be undermined and the dam would be destroyed.

In addition to the danger from undermining, there is the additional danger that water percolating through the cracks of the rock will exert an upward pressure upon the sloping sur-

face, and that one or more sections of the dam will slide bodily down stream [illegible].

In view of the foregoing conditions, it is my opinion that this dam does not possess the degree of safety which the Commission has the right to demand. It should be noted, however, that the pondage above the dam is small, and that the failure of the dam would not cause any appreciable flood wave.

Two remedies appear to be open. The first would be to construct the dam in its present location, but add to it a roller-way extending from the top of the dam down below the surface to the bottom of the pool below, there giving the water a horizontal direction by an O. G. curve. The second remedy, and probably the best and cheapest solution of the problem, is to abandon the proposed site entirely and build a dam at a point further up stream. This is entirely feasible, but in any case it is believed that in view of the character of the rock at this locality a roller-way and surface protection of the rock below are essential.

Very respectfully yours,

(Signed) A. H. Perkins,

AHP/F

Division Engineer.

FILE

International Paper Company's Dam
at Palmer's Falls.

Conservation Commission, (Particular Attention of Commissioner Moore),

Albany, N. Y.

Gentlemen:-

In the matter of the application of the International Paper Company dated July 14th, 1913 for approval of its plans and specifications for a new dam in the Hudson River at Palmer's Falls, known in our records as Serial No. 93, Upper Hudson Watershed No. 361, said plans and specifications being submitted herewith, I hereby report adversely upon the subject of the approval of said plans and specifications for the reasons hereinafter set forth.

The General Location.

The International Paper Company has a large plant at Palmer's Falls with a dam across the Hudson River. The mill buildings are located on the west bank in the westerly part of the river channel. In this locality the river flows in a deep gorge, bottom and sides of which are of granite or gneiss rock formation. There is a natural water falls of about 45 feet in height. The mill buildings are at and near the westerly part of the natural water falls, while the surplus and flood water flow passes over the remainder of the natural falls in the easterly part of the channel. (For descriptive purposes herein, the river is assumed to flow in a southerly direction).

The Existing Old Timber Dam.

The International Paper Company's dam is of timber, extending from its mills and forebay in a diagonal direction upstream to the easterly wall of the gorge at a point several hundred feet upstream from the westerly end of the dam. A map of the location, show-

ing the relative positions and elevations of points of importance connected with this report is attached hereto and marked "Appendix A".

The flood of March 1913 carried out a section of the dam about 210 feet in length.

The location of the timber crib dam, as it existed before the flood of March 1913 and as reconstructed, is shown. A small part of the location was changed in reconstruction. The height of this dam ranges from 11 feet to 31 feet. The present length of the overflow weir is 550 feet, being about 115 feet shorter than before said flood and reconstruction.

As, at the time of rupture, the river was very high and as the quantity of water impounded by the dam is small, the partial failure of the dam made no appreciable impression on the flood height below the natural falls, and damage, so far as we know, was confined to the property of the International Paper Company.

The gap in the dam has been restored and the dam somewhat repaired, and it is now in service and seemingly as good and useful as before the said flood. The dam is old, and while due to decay etc., it cannot last for an indefinite period, still, with some not very extensive additional repairs, it can be made serviceable for several years to come.

Proposed New Dam.

As to plans, location and foundation submitted and proposed by the International Paper Company, I do not question that upon a location and foundation safe against undermining and sliding such a

general design of a dam would be safe. It has an objectionable feature, however, in that the water falling over the crest of the dam makes an unobstructed drop through the air to the elevation of the base below, in this case a drop of from 40 to 85 feet. The general design would be improved by extending the piers downstream with "O. G." fronts and constructing an apron thereon, thus supporting the water in its descent and discharging it in a horizontal current from the foot of the dam, thus avoiding all impact from the falling water.

To apply this principle on the location proposed, would require the concrete structure to extend to a rock foundation below the natural falls and would make this part of the structure nearly 100 feet high, extending over a considerable part of the length of the dam, and at a lesser height over the remainder, and would be so very expensive that some other design, with a location at greater distance upstream from the crest of the falls, would be, for a number of reasons, much safer as well as less costly.

The length of the proposed overflow weir is 376 feet compared with 530 feet on the existing timber dam and 665 feet as it was before this season's reconstruction.

The maximum flood flow, based upon the calculations made of the flow at Spier's Falls last March, is 100,000 second feet, which would cause a sheet of water 15 feet deep on the crest to flow over the proposed 376 feet long weir. This sheet of water 15 feet deep

International Paper Company's Dam
at Palmer Falls. #4.

by 376 feet long would drop from 40 to 85 feet through the air at different parts of the proposed dam, the 85 feet drop being where the proposed location of the dam is so close to the crest of the natural falls that the sheet of falling water would drop from the crest of the dam unobstructed or checked into the pool at the foot of the falls.

The terrific force of this mighty column of water as it collides with the rock below after an unobstructed fall of from 40 to 85 feet through the air, and its power to cut away even rock and to do so rapidly and in large quantities, are well known and easily appreciated by persons having to do with such subjects and to intelligent men generally.

The ordinary flow of Niagara River is 210,000 second feet (95% of which passes over the Canadian Falls), the whole being a little more than twice the maximum flood flow of the Hudson River at Palmer Falls. This affords a comparison easily appreciated by any person who has viewed Niagara Falls.

The length of the crest of Niagara Falls is - American channel, 950 feet, Canadian channel, 2400 feet - total, 3350 feet as scaled from maps.

For data as to Niagara Falls, made use of herein, refer to "62 d Congress, 1st Session, Senate Document 105." See Plate 10 therein. Quoting from page 32 thereof -

"During these thirty-one years the recession of the crest of ... reaching a maximum of 170 feet

on the general trend of the central chute or apex." The thirty-one years are from 1875 to 1906.

The water has loosened and carried away such a vast quantity of rock in thirty-one years as to cause the apex of Horseshoe Falls to move upstream 170 feet. When white men first saw this great falls, the crest was a long distance downstream from where it now is.

This is referred to here to show the astonishing effect of a heavy body of falling water in cutting and carrying away vast quantities of rock.

With the design of dam submitted by the International Paper Company constructed on the proposed site, I entertain no doubt that within a few years at most, due to undermining or sliding or both, the dam would fail.

The site of this proposed dam has been inspected by Commissioner Moore, the Chief Engineer, the Division Engineer, and Assistant Engineers Suter, Sargent and Cullings. The Division Engineer and each assistant engineer have made separate reports upon the dam site and local physical conditions. Said reports are submitted herewith, marked respectively as "Appendices B, C, D and E." The report of the Division Engineer clearly sets forth the physical conditions, and the opinions of its author are entitled to credit.

In the report of Assistant Civil Engineer Suter, the subject is ably treated, and particular attention is called to his statements and conclusions upon the subject of water falling vertically from dams and from natural water falls and the astonishing action resulting upon rock or other material at and near the base of the falls.

Assistant Civil Engineer Sargent in his report sets forth his views clearly as to the hazardous features of the proposed site and construction combined.

Assistant Civil Engineer Cullings has carefully calculated the stresses in the dam structure as designed and the forces tending to cause the dam to slide on or with the underlying rock. His mathematical conclusions are clearly set forth in the blue prints which he makes a part of his report. He shows that the design of the dam submitted would be safe per see if built upon a foundation free from undermining and sliding hazards.

The Division Engineer and the three assistant civil engineers have made their several reports as distinctly their own individually. None of them hawebeen inspired or influenced by the Chief Engineer.

Respectfully submitted,

R W Sherman

Chief Engineer.

RWS/H.

June 17, 1913.

International Paper Co.,

30 Broad Street,

New York City, N. Y.

Gentlemen:-

Tentative plans for the proposed work at Corinth (dam #361 Upper Hudson) received. I cannot, however, see how the same provides for the maximum flow. Last March the flow was about 95,000 feet second and it could be more. The dam should provide for this flow with the flash boards in, unless they are so constructed that they will float off with their own buoyancy when overtopped. I presume, in cases where the rock is not rough, as shown on the drawings, so the dam can obtain a good hold thereon, that two inch iron anchors, going through two layers of the rock bed, would make up the deficiency.

When sending prints for approval, kindly have a slip of paper, 3 inches by 6 inches, placed on the tracing near the lower right hand corner for the stamp of approval, as stated in the requirements on the application blank.

International Paper Co. #2.
June 17, 191[illegible].

In filling out the application blank, kindly show how the maximum flow is to be taken care of.

Very truly yours,

Conservation Commission,

By

Inspector of [illegible],

McK/C.

International Paper Company
30 Broad Street
New York

June 23rd, 1913.

Re - HUDSON RIVER DAM

The Conversation Commission,
Mr. Alex. Rice McKim, Inspector of Docks & Dams,
Albany, N. Y.

Dear Sir:-

I have your letter of June 17th in reference to dam #361 - Upper Hudson.

The best information we have shows the amount of water passing Corinth during the March flood to have been 89,000 cubic feet per second.

We have designed a crest in accordance with the Cornell experiments, to obtain the best possible coefficient of discharge. The coefficient for the crest as we have designed it will be, in accordance with our opinion and that of Mr. H. de B. Parson's, at least 4; which would give a discharge of 89,000 cubic feet per second with a depth over the crest of 15.4 feet.

It is of course intended that the flash boards shall go out if the water has risen six to eight feet over them. The only damage which would be done if the flash boards would not go out would be flooding back on Warren Curtis Mill, next above us.

We will of course ask you to examine the foundation bed before we start the dam, and if we cannot suitably prepare the foundation otherwise we will put in the pins as you suggest.

In sending you prints for approval, we will as you ask leave a white space on them for your approval stamp.

Yours very truly,

A H White

AHW/A.

CHIEF ENGINEER.

B. C. Form 51-S 361 .4/.H

REPORT OF TESTS FOR BARGE CANAL

STATE OF NEW YORK
DEPARTMENT OF STATE ENGINEER AND SURVEYOR
TESTING LABORATORY
ALBANY

Tests of Sand from .... bank at Corinth, N. Y.,
for use on Contract No. ...., Res. No. Conservation Commission ~~Canal~~, ... Division.
Contract Sample No. .... taken ....; received at Laboratory ....; made up July 8
Sand is composed of quartz and calcite with some hornblende and magnetite – all somewhat coated.
Percentage of Voids 32.0; Loam 1.6; Organic matter ——
Parts of sand to cement by ~~weight~~ bulk :— 3 sand to 1 cement. Per cent water used ±12
Temperature of water used in mixing .... Fahr. Briquettes kept in moist air 24 hours and then immersed.
Cement used in tests, Cement from Corinth, N.Y. This cement tested as follows:—
Sets (determined by Vicat needle):—Initial, { in 140 min. / Minim. requirement, 30 min. } ; hard, { in 350 min. / Requirement, 60 to 600 min. }
Constancy of Volume Tests:—Normal air Good; Normal water Good; Accelerated Good
Fineness (per cent passing sieve of 2,500 meshes per square inch) 99.3 (Requirement, 99%)
" (" " " " 10,000 " " " ") 92.3 (Requirement, 92%)

TENSILE STRENGTH IN POUNDS PER SQUARE INCH						SIZE OF SAND	
STANDARD QUARTZ SAND		NATURAL SAND		WASHED SAND		PASSING SIEVE	
7 Days	28 Days	7 Days	28 Days	7 Days	28 Days	No.	Per Cent
242		—		106		2	98.2
254		25		109		4	91.6
234		26		117		6 (1/8")	87.2
219		29		119		10	76.8
240		36		108		20	50.4
1189		116		559		30	33.8
238		29		112		40	18.0
						60	7.0
						74	3.0
						100	1.6
						140	1.0
						200	0.8

Remarks: Sample of cement received used in making tests.
Sample of crushed stone – a good limestone. Foundation stone – felsite and gneiss.

I CERTIFY *that this is a true abstract taken from the records of tests* July 15 1913

Russell S. Greenman
Resident Engineer in Charge of Tests

July 15, 1913.

Concerning the samples for Dam #361 Upper Hudson at Palmer's Falls, sent to the & Laboratory for Testing.

International Paper Co.,

30 Broad St.,

New York City, N. Y.

Gentlemen:-

We found that the cement with five samples on a seven days test with standard quartz sand averaged 238 pounds per square inch. With the sand which you sent, the average of four samples on a seven days test was but 28 pounds per square inch and the average of five samples of the sand you sent washed averaged 112 pounds per square inch. The result of the tests on the sand, as you see, were very poor due to insoluble coating of loam, and sands of that nature always give a very low initial result. Often, however, these sands on a longer test give better results, but I think it unwise to use this sand for your dam.

The samples of crushed stone were composed of a good limestone and should give very good results. The foundation bed itself is composed of felcite and gneiss.

International Paper Co. #2
July 15, [illegible].

I suggest that you submit another sample of sand, for which I enclose a tag. 7/3

Very truly yours,

Conservation Commission,

By

Inspector of Docks and Dams.

McK/C.

Encl.

FILE

[illegible]D

1913

D[illegible] WATERS

Chief Engineer

Matter disposed of by phone & in interviews. No written reply. RWS.

International Paper Company

30 Broad Street

New York July 30, 1913.

Conservation Commission,
Albany, N. Y.
Mr. R. W. Sherman, Chief Engineer.

Dear Sir:

Your communication of July 29th addressed to this Company and delivered this day by hand of your division engineer, Mr. A. H. Perkins, has been repeated to the writer by telegraph.

Until my assistant, Mr. Hutchins, told me over the telephone to-day, I knew nothing of the visit of your Mr. Cullings to Corinth.

The last communication I have had from the Commission is a letter by Mr. McKim under date of July 15th, in which the receipt of plans, specifications, etc. were acknowledged. We are greatly surprised and somewhat distrubed by your letter of July 29th. We had discussed the type of dam with Mr. McKim. We are interested in a dam of the same type in Maine - 65 feet high, and impounding 8 billions of cubic feet of water. This type of dam was suggested by the writer for the reservoir in Maine, and was adopted by a Board of well known engineers.

Our design of dam for our Hudson River Mill was very carefully worked out, and carefully checked up by our consulting engineer, Mr. H. de Barclay Parsons.

I think if you will give me an interview I can show you the great advantages of this type of dam over the ordinary solid section.

As to the foundations at Hudson River Mill, I can only say, that Mr. McKim examined the foundations and expressed himself as highly satisfied

and told us to go right ahead, and that we would get the Commission's approval promptly after sending in the application. If, as I understand Mr. Perkins says, Mr. McKim exceeded his authority, we are unfortunate, and while we feel that we were about to build on a perfectly safe foundation, we of course stand ready to follow your instructions.

I am endeavoring to arrange with you to visit the site of the work with me, and trust that I may be successful.

Respectfully yours,

INTERNATIONAL PAPER COMPANY,
By- A. H. White
Chief Engineer.

[illegible]

Chief Engineer Sherman.

Dear Chief:

Commissioner Moore directs me to let you know that that Mr. Perkins took up the matter of the new Palmer Falls dam of the International Paper Company just before he left Thursday, and gave him instructions to lay the whole thing before you by wire.

Now it appears that these people are proceeding in advance of the approval of the plans and are thereby in conflict with the law.

Please telephone Mr. White, Chief Engineer of the I. P. Co. and make it plain to him that construction work must cease until he notifies you. He ought to realize that he should should not proceed upon the verbal assurance of any employee of the Commission.

The Commissioner further says to "GET THIS DAM RIGHT."

Yours very truly,

J. M.

JDM/M

Aug. 7, 1913.

Hon. John D. Moore, Commissioner,

Conservation Commission,

[illegible]

Dear Sir:-

Your telegram of yesterday in reply to mine of the same date reached me this morning.

[illegible] day morning in company with Division Engineer [illegible] Chief Engineer White of the International Paper Company [illegible] toga, and with him in his auto we went to Palmer Falls and onto the site of the dam. I there read to Mr. White yours of the 4th inst. signed by J. M[illegible]rs, which reads as follows:

> "Commissioner Moore directs me to let you know that Mr. Perkins took up the matter of the new Palmer Falls dam of the International Paper Company just before he left Thursday, and gave him instructions to lay the whole thing before you by wire.
>
> Now it appears that these people are proceeding in advance of the approval of plans, and are thereby in conflict with the law.
>
> Please telephone Mr. White, Chief Engineer of the I. P. Co., and make it plain to him that construction work must cease until he notifies [illegible]. He ought to realize that he should not proceed upon the verbal assurance of any employee of [illegible] Commission.
>
> The Commissioner further says to "GET THIS DAM RIGHT".

I then [illegible] the above to Mr. White and he read it [illegible]

[illegible] he immediately ordered the [illegible]

of all construction work upon the proposed dam, laying off a considerable number of men who were engaged in rock excavation, [illegible], [illegible], etc.

Mr. Perkins and I made a very careful inspection of the site, and as far as possible all features connected with the proposed dam, and as a result I became more than ever convinced that by reason of the possibility - almost probability - even bordering upon certainty - that the overflow of the immense volume of Hudson [illegible] falls, [illegible] the crest of the [illegible] upon the rock at and near the brink of the falls upon which the site is located, would tear out the rock & undermine the dam to an extent that would cause the same to slide either upon or with the rock which has a decided dip down stream, and cause the dam to rupture and fall in part or as a whole over the precipice, and that the plans and specifications submitted by the owner should not be approved by the Conservation Commission.

After the inspection, I stated to Chief Engineer White that when Commissioner Moore and myself inspected the site and examined the plans some weeks ago we were impressed with the danger from undermining and sliding, and that upon my present inspection I was still more forcibly impressed in the same direction, and would not approve the plans upon the proposed site.

Mr. White asked numerous questions. He desired to know if the Commission would sustain my views, to which I replied that I thought so but it did not necessarily follow. He wished to know if you were of the same opinion as myself, and I said that I believed you [illegible]

[illegible]

would not cause risk to life or property other than that of the [illegible] Company. I [illegible] that I could not say what action the Commission would take in any branch of the subject, but as I understood it it was the policy of the Commission to approve only such designs and locations for dams as would lead to the building of structures which the Commission believed could not fail.

Mr. White was anxious that you return from [illegible] and again inspect the dam, and I said that I would ask you to do so but in my opinion you would not come. He wished me to telephone you, which I declined to do. He asked for your telephone address, which I gave him, in order that he might telephone you if he chose to do so.

Mr. White further asked if he could appeal to the Courts from the decision of the Commission. I said that I would not pass upon any law points, but personally I had no doubt of their right to do so.

Later in the day he (Mr. White) talked about abandoning the building of a new dam altogether for the time being at least, and continuing to use the existing timber dam by somewhat strengthening the repairs which they have lately made upon it.

Mr. White made numerous statements to which I made no reply. He threw out ideas as to construction, etc., as to which I was silent. He seemed to exhaust all the art and ingenui[illegible] which he [illegible] and dam location, in which efforts, I need scarcely say, he did not succeed.

From [illegible] Falls we continued with Mr. White in [illegible] to Fort William Henry Hotel, where we dined (not at his expense), and from there we went to Glens Falls where, at his request, we inspect[illegible] the site of their [illegible] work which you and I lately inspected. We left Mr. White at his Company's office in Glens Falls, and took the three o'clock (P. M.) train for Albany. Doubtless Mr. White is a great engineer, but he doesn't know much about law.

As you so clearly state in your telegram, the law makes approval of plans by Conservation Commission an indispensable preliminary to construction, and therefore responsibility is placed directly upon the Company. The Commission has taken no action and therefore there is nothing from which to appeal. The law does not require the Commission to take negative action. If plans and specifications submitted to the Commission by the owners for approval are not approved, the remedy of the owners is by Mandamus, and as I view it that is the only legal resort the International Paper Company has at the present time.

Mr. Perkins thinks that the International Paper Company will resort to some legal proceedings. Of course they may, but I do not feel confident that they will. By way of prediction, I think it more likely that they will drop the matter altogether for the present, patch up their old timber dam a little more so that it will answer a few years longer, and that they will finally resort to a safe design and location for their new dam in lieu of the present design and location combined. This sets forth the [illegible] I [illegible], and as I view it we need do nothing but await such action as the International

Paper Company chooses to take, either by legal proceeding or by submitting some other plan. Possibly they may ask for a hearing [illegible] plan and location.

I note that you are opposed to employing outside engineering experts. If Mandamus Proceedings against the Commission are instituted, it may then be advisable to employ such experts, but I concede that there is at least nothing urgent about doing so at [illegible].

Yours respectfully,

Chief Engineer,

Conservation Commission.

RWS/F

B. C. Form 515

Report of Tests for Barge Canal

STATE OF NEW YORK
DEPARTMENT OF STATE ENGINEER AND SURVEYOR
TESTING LABORATORY
ALBANY

Tests of Sand from International Paper Co. for Curtis Pit. Palmer, N. Y.,
for use on Contract No. Dam at Palmer on the Hudson River Division.
Contract Sample No. taken ; received at Laboratory ; made up Aug. 1.
Sand is composed of quartz, feldspar, and calcite with some hornblend and trace of magnetite. Coarse grains are granite.
Percentage of Voids 38.2 ; Loam 1.0 ; Organic matter +
Parts of sand to cement by ~~weight~~ bulk :— 3 sand to 1 cement. Per cent water used ±12
Temperature of water used in mixing 75 Fahr. Briquettes kept in moist air 24 hours and then immersed.
Cement used in tests Standard Cement This cement tested as follows:—
Sets (determined by Vicat needle):--Initial, in 190 min. (Minim. requirement, 30 min.); hard, in 570 min. (Requirement, 60 to 600 min.)
Constancy of Volume Tests:—Normal air Good ; Normal water Good ; Accelerated Good
Fineness (per cent passing sieve of 2,500 meshes per square inch) 99.8 (Requirement, 99%)
" (" " " " 10,000 " " " ") 96.6 (Requirement, 92%)

TENSILE STRENGTH IN POUNDS PER SQUARE INCH — SIZE OF SAND

Standard Quartz Sand 7 Days	Standard Quartz Sand 28 Days	Natural Sand 7 Days	Natural Sand 28 Days	Washed Sand 7 Days	Washed Sand 28 Days	Passing Sieve No.	Passing Sieve Per Cent
224	345	92		100		2	98.6
205	270	94		99		4	95.8
225	302	92		95		6 (1/8")	93.4
216	312	86		102		10	89.8
218	328	106		105		20	74.6
1088	1557	470		501		30	45.8
218^-2	311^+2	94		100^+1		40	22.4
						60	9.0
						74	4.2
						100	0.8
						140	0.4
						200	0.3

Remarks:

I CERTIFY *that this is a true abstract taken from the records of tests* Aug. 8 + 12 1913

Russell S. Greenman
Resident Engineer in Charge of Tests

B. C. Form 51 S

3949 100 (6353)

REPORT OF TESTS FOR BARGE CANAL

STATE OF NEW YORK
DEPARTMENT OF STATE ENGINEER AND SURVEYOR
TESTING LABORATORY
ALBANY

Tests of Sand from International Paper Co. ~~bank~~ at Palmer, N. Y.,
for use on Contract ~~No.~~ Dam, ~~Res. No.~~ at Palmer N.Y. ~~Canal~~, Division.
Contract Sample No. taken ; received at Laboratory ; made up Aug. 1
~~Sand is~~ Sample is "Iron Ore Tailings".

Percentage of Voids 32.7 ; Loam — ; Organic matter —
Parts of sand to cement by ~~weight~~ bulk :— 3 sand to 1 cement. Per cent water used ± 10½
Temperature of water used in mixing 75 Fahr. Briquettes kept in moist air 24 hours and then immersed.
Cement used in tests, Standard " Cement. This cement tested as follows:—
Sets (determined by Vicat needle):—Initial, in 190 min. (Minim. requirement, 30 min.) ; hard, in 370 min. (Requirement, 60 to 600 min.)
Constancy of Volume Tests:—Normal air Good ; Normal water Good ; Accelerated Good
Fineness (per cent passing sieve of 2,500 meshes per square inch) 99.8 (Requirement, 99%)
" (" " " " 10,000 " " " ") 96.6 (Requirement, 92%)

TENSILE STRENGTH IN POUNDS PER SQUARE INCH						SIZE OF SAND	
STANDARD QUARTZ SAND		NATURAL SAND		WASHED SAND		PASSING SIEVE	
7 Days	28 Days	7 Days	28 Days	7 Days	28 Days	No.	Per Cent
224	345	202				2	100.0
205	270	216				4	98.6
225	302	230				6 (¼")	87.4
216	312	231				10	66.8
218	328	242				20	42.2
1088	1557	1121				30	28.2
218	311	224				40	20.8
						60	15.0
						74	12.2
						100	8.4
						140	6.4
						200	5.2

Remarks:

I CERTIFY *that this is a true abstract taken from the records of tests* Aug 8 + 12 1913

Russell S. Greenman
Resident Engineer in Charge of Tests

B. C. Form 51 S

3-949-1000 (6-3-13)

Report of Tests for Barge Canal

RECEIVED

AUG 12 1913

DIVISION INLAND WATERS

STATE OF NEW YORK
DEPARTMENT OF STATE ENGINEER AND SURVEYOR
TESTING LABORATORY
ALBANY

Tests of Sand from Corinth N.Y. ~~bank at~~ J. D. M. N. Y.,

for use on Contract No. , ~~Res. No~~ Conservation Commission ~~Canal~~, Division.

Contract Sample No. taken ; received at Laboratory ; made up July 8

Sand is composed of quartz and calcite with some hornblend and magnetite — all somewhat coated

Percentage of Voids 32.0 ; Loam 1.6 ; Organic matter —

Parts of sand to cement by ~~weight~~ bulk :— 3 sand to 1 cement. Per cent water used 12.

Temperature of water used in mixing 72 Fahr. Briquettes kept in moist air 24 hours and then immersed.

Cement used in tests, Cement received from Corinth This cement tested as follows:—

Sets (determined by Vicat needle):—Initial, in 140 min. (Minim. requirement, 30 min.); hard, in 350 min. (Requirement, 60 to 600 min.)

Constancy of Volume Tests:—Normal air Good ; Normal water Good ; Accelerated Good

Fineness (per cent passing sieve of 2,500 meshes per square inch) 99.3 (Requirement, 99%)

" (" " " " 10,000 " " " ") 92.3 (Requirement, 92%)

TENSILE STRENGTH IN POUNDS PER SQUARE INCH — SIZE OF SAND

Standard Quartz Sand 7 Days	Standard Quartz Sand 28 Days	Natural Sand 7 Days	Natural Sand 28 Days	Washed Sand 7 Days	Washed Sand 28 Days	Passing Sieve No.	Per Cent
242	307	—	75	106	79	2	98.2
254	300	25	77	109	92	4	91.6
234	300	26	69	117	99	6(1/8")	87.2
219	305	29	75	119	85	10	76.8
240	302	36	76	108	89	20	50.4
1189	1514	116	372	559	444	30	33.8
238 -1	303 -1	29	74 +2	112 -1	89 -1	40	18.0
						60	7.0
						74	3.0
						100	1.6
						140	1.0
						200	0.8

Remarks:

I CERTIFY *that this is a true abstract taken from the records of tests* Aug 5 1913

Russell S. Greenman
Resident Engineer in Charge of Tests

FORM 177 57

Chief Engineer
DIVISION INLAND WATERS
AUG 9
RECEIVED

GEORGE E. VAN KENNEN,
CHAIRMAN
JAMES W. FLEMING,
JOHN D. MOORE,
COMMISSIONERS
ALBERT E. HOYT,
SECRETARY
JOHN J. FARRELL,
ASST. SECRETARY

IN REPLYING PLEASE REFER
TO FILE NUMBER

FILE

STATE OF NEW YORK

ORIGINAL

CONSERVATION COMMISSION

ALBANY

DIVISION OF INLAND WATERS
JOHN D. MOORE,
COMMISSIONER
JAMES J. FOX,
DEPUTY COMMISSIONER
RICHARD W. SHERMAN,
CHIEF ENGINEER
ALEXANDER MCKIM,
INSPECTOR OF DOCKS AND DAMS

AUG 9
DIVISION INLAND WATERS
Chief Engineer

130

Aug. 9, 1913.

Mr. R. W. Sherman, Chief Engineer,

Conservation Commission,

Albany, N. Y.

Dear Sir:-

Complying with your request for a report upon the proposed dam at Palmer Falls, I have visited the site four different times, and have examined the drawings and requested Mr. Cullings to figure out the stresses in the proposed structure.

I may state as a result of these investigations in general that the design of the dam appears to be well within good engineering practice, provided it were to be placed upon a suitable foundation. The question of the safety of this dam, therefore, reduces itself to one of judgment as to the safety of the foundations under the conditions that would exist with the dam erected.

In the first place, it should be noted that the rock has well defined cleavage planes in two directions, at an angle of approximately 120 degrees. The cleavage planes most nearly horizontal dip at an angle of about 15 to 20 degrees down stream. Back of the proposed dam there is a fault in the rock, and the water has taken out the rock broken up by the faulting, leaving a deep hole along the edge of which the heel of the proposed dam

would come over about three-fourths of the length of the dam. This line of faulting passes under the proposed location of the sluice gates and head gates. The dam is thus located upon a triangularly shaped mass of rock which, near its end near the sluice gates, is not over 30 ft. wide, and drops off to the lower pool of the river very steeply. These conditions might be described at greater length, and should be in case it is desired to explain the conditions to one wholly unfamiliar with the proposed work.

The ~~rainfall~~ runoff of the Hudson at this point may be expected to reach at times of maximum flood over 100,000 sec. ft., the discharge at Spier Falls having been over 90,000 sec. ft. during the last spring, and the drainage areas at the two points are but slightly different. This discharge would require a depth on the spillway of about 15 ft. This mass of water plunging from the top of the dam onto the shattered rock beneath would very probably take out everything in front of it, stripping off the rock layer by layer. The undermining action of this sheet of water falling through the height from the top of the dam to the level of the lower pool, which is 85 ft., cannot but result in further undermining the shattered rock. There is, therefore, great danger that in flood the portion of the dam resting upon the narrower part of the rock tongue would be undermined and the dam would be destroyed.

In addition to the danger from undermining, there is the additional danger that water percolating through the cracks of the rock will exert an upward pressure upon the sloping sur-

face, and that one or more sections of the dam will slide bodily down stream along some cleavage plane.

In view of the foregoing conditions, it is my opinion that this dam does not possess the degree of safety which the Commission has the right to demand. It should be noted, however, that the pondage above the dam is small, and that the failure of the dam would not cause any appreciable flood wave.

Two remedies appear to be open. The first would be to construct the dam in its present location, but add to it a roller-way extending from the top of the dam down below the surface to the bottom of the pool below, there giving the water a horizontal direction by an O. G. curve. The second remedy, and probably the best and cheapest solution of the problem, is to abandon the proposed site entirely and build a dam at a point further up stream. This is entirely feasible, but in any case it is believed that in view of the character of the rock at this locality a roller-way and surface protection of the rock below are essential.

Very respectfully yours,

A. H. Perkins

Division Engineer.

AHP/F

The above Report is Approved by,
R. W. Sherman,
Chief Engineer.

AUG 9 1913
DIVISION OF INLAND WATERS

STATE OF NEW YORK

ORIGINAL

CONSERVATION COMMISSION

ALBANY

Aug. 9, 1913.

Mr. R. W. Sherman, Chief Engineer,

Conservation Commission,

Albany, N. Y.

Dear Sir:-

In answer to your verbal request, I beg to submit the following report on the site of the dam proposed to be built by the International Paper Company at Palmer Falls.

In company with Division Engineer Perkins and Assistant Civil Engineer Suter and Cullings, I made an inspection of this dam site on August 8th. I made no technical examination of the plans, and it is assumed that the dam per se has been safely designed.

It is proposed by the International Paper Company to build a dam across the Hudson River, which is about 200 ft. wide at its narrowest point in this vicinity, immediately below their present dam, part of which was carried out by the floods of last spring. At the present time there is available a gross head of 83 ft. at the mill. The new dam is to be about 38 feet in height, and is to consist of eighteen concrete arches of 15 ft. span between concrete piers 4 ft. thick. Should a flood occur of the magnitude of that of last spring, there would be a depth of water of 18 feet on the spillway, which is planned to have a total length of 383 feet.

The dam is situated on the crest of an abrupt falls approximately 20 feet high, giving a total fall of 60 ft. from the crest of the dam. About 40 ft. above the dam is a pocket 40 ft. long and 30 ft. deep at its deepest point; with 18 ft. of water on the crest of the dam it would give a total head of 88 feet, tending to uplift the foundation.

The foundation of the dam, which is a granite gneiss, is distinctly stratified and has a dip down-stream estimated at 15 degrees, and is fissured in several places both vertically and horizontally, the vertical cracks being the wider.

It would seem apparent that as no apron is proposed to be constructed, the water with its clear fall of 60 ft. to 80 ft. would undermine the fissured rock at the base of the dam, thereby endangering the structure and making its eventual failure almost certain.

The pondage created by this dam would be small, and should the dam fail but little damage would probably result to the property below. It would not, however, seem advisable for the Conservation Commission to give its approval of the plans of a dam which seems liable to fail, even though the resulting damage might be slight.

In the writer's opinion, the best way to build a dam at this point would be to construct a concrete dam between the points where the new dam is being built, arching the dam upstream. A low secondary dam could be built a short distance below, creating a pool which would act as a water cushion for the flood flows over the main dam.

Without doubt, the proposed dam in its present location could be made safe by the construction of an apron, but probably at a prohibitive cost.

Respectfully submitted,

(Signed) Edward H. Sargent.

EHS/F

Asst. Civil Engr.

FILE

International Paper Company
30 Broad Street
New York

Aug. [illegible]

[illegible]erman. Chief Engineer,
Conservation Commission,
Albany, N. Y.

Dear Sir:-

We are sending you herewith duplicate copies of application for x[illegible] at Palmer.

Hoping this will answer your requirements, we are

Yours very truly,

A. H. White
E.H.

EH/B

CHIEF ENGINEER.

x should read Construction
R H Sherman
Chief Engr

Sept. 2, 1913.

Mr. O. H. White, Chief Engineer,

International Paper Co.,

30 Broad St., New York.

Dear Sir:-

Yours of the 29th ult. with enclosures as stated was duly received.

In your letter you use the word "reconstruction" while in the application you use the word "construction". The latter is correct.

At a meeting of the Conservation Commission held this morning, plans covered by your application for both the new dam and repairs to the existing crib dam at Palmer's Falls, your new dam at Glens Falls, and repairs, reconstruction, etc., to your dam at your mill "C" on Black River were all duly approved, as to all of which you will be further formally advised through the Secretary.

Yours truly,

Conservation Commission,

By

Chief Eng.

RWS/F

Inspection . OK 9/2/13 Gray X

WHEREAS the International Paper Company, having an office at 30 Broad Street in the City of New York, did on the 18th day of August, 1913, submit plans and specifications for additional repairs and strengthening of a dam located in the Hudson River in the Towns of Corinth and Luzerne in Saratoga County, said dam being known in Conservation Commission records as dam No. 361, Upper Hudson Watershed, and did by Conservation Commission Serial No. 110 make application for the approval of said plans and specifications under the provisions of the Conservation Law, and

WHEREAS said plans and specifications have been approved by the Chief Engineer and the Inspector of Docks and Dams and said plans signed by them respectively.

NOW THEREFORE BE IT RESOLVED that said plans and specifications be and hereby are approved, provided, however, that this resolution shall not be deemed to authorize any invasion of any property rights, public or private, by any person in carrying out the requirements of this resolution, nor to create any claim or demand against the State of New York.

FORM IW 67

GEORGE E. VAN KENNEN, CHAIRMAN
JAMES W. FLEMING,
JOHN D. MOORE,
COMMISSIONERS
ALBERT E. HOYT, SECRETARY
JOHN J. FARRELL, ASST. SECRETARY

RECEIVED
1914
DIVISION OF INLAND WATERS
Chief Engineer

IN REPLYING PLEASE REFER TO FILE NUMBER

FILE

STATE OF NEW YORK

CONSERVATION COMMISSION

ALBANY

DIVISION OF INLAND WATERS
JOHN D. MOORE, COMMISSIONER
JAMES J. FOX, DEPUTY COMMISSIONER
RICHARD W. SHERMAN, CHIEF ENGINEER
ALEX. RICE McKIM, INSPECTOR OF DOCKS AND DAMS

Jan. 28, 1914.

Mr. R. W. Sherman, Chief Engineer,
Conservation Commission,
Albany, N. Y.

Dear Sir:-

In accordance with your verbal instructions of the 24th inst., I have today inspected Dam No. 361, Upper Hudson, recently constructed by the International Paper Company across the Hudson River at Palmer Falls. Owing to a sleet storm on Saturday, followed by a heavy snow storm which left all masonry and machinery covered with ice and snow, it was impossible to make a thorough inspection of the dam. So far as can be seen, however, the dam appears to have been constructed in a thorough and pains-taking manner, and in accordance with the revised plans approved by the Conservation Commission August 19, 1913. The structure is practically complete, except for the placing of three or four gate-stands, and the closing of the sluice left open to take care of leakage through the old crib dam. The hand-rail has not yet been placed on the bridge through the dam, as shown on plans. Mr. Ashworth, superintendent for contractor, states that he will be ready to place the dam in service at the end of the present week. I see no engineering reason why formal permission to use this dam should not be granted.

Respectfully yours,

E. S. Cullings
Assistant Engineer.

ESC/F

Address all communications to the Conservation Commission.

International Paper Company
30 Broad Street
New York

PHILIP T. DODGE
PRESIDENT

Jan 23 1914

January 22nd, 1914.

RECEIVED
JAN 23 1914
DIVISION INLAND WATERS
J. D. M.

The Conservation Commission,

Albany, N. Y.

Gentlemen:-

We beg to notify you that our dam on the Hudson River in the towns of Corinth and Luzerne, and known by you as Dam No. 361 Upper Hudson Watershed, Serial No. 93, is finished and ready to receive the water with the exception of filling a small sluice. We make this notification so that if you so desire you may have the dam inspected before it receives the water pressure.

As we desire to close the sluice within the next few days, we would like to hear from you immediately.

Yours very truly,
INTERNATIONAL PAPER COMPANY,
P. T. Dodge
PRESIDENT.

AHW/A.

11-80-11 3000 (16-10462)

Fill out a form as complete as possible for each dam in your district and send to State Conservation Commission, Albany, N. Y.

1. Name and address of owners [illegible]
2. Date of construction [illegible]
3. Uses of impounded water Power purposes
4. Character of foundation bed Granite
5. Material of waste spill Concrete
6. Length of waste and depth below dam [illegible] 10 [illegible]
7. Total length of dam including waste About 75 [illegible]
8. Material of dam
9. Discharges, size and location

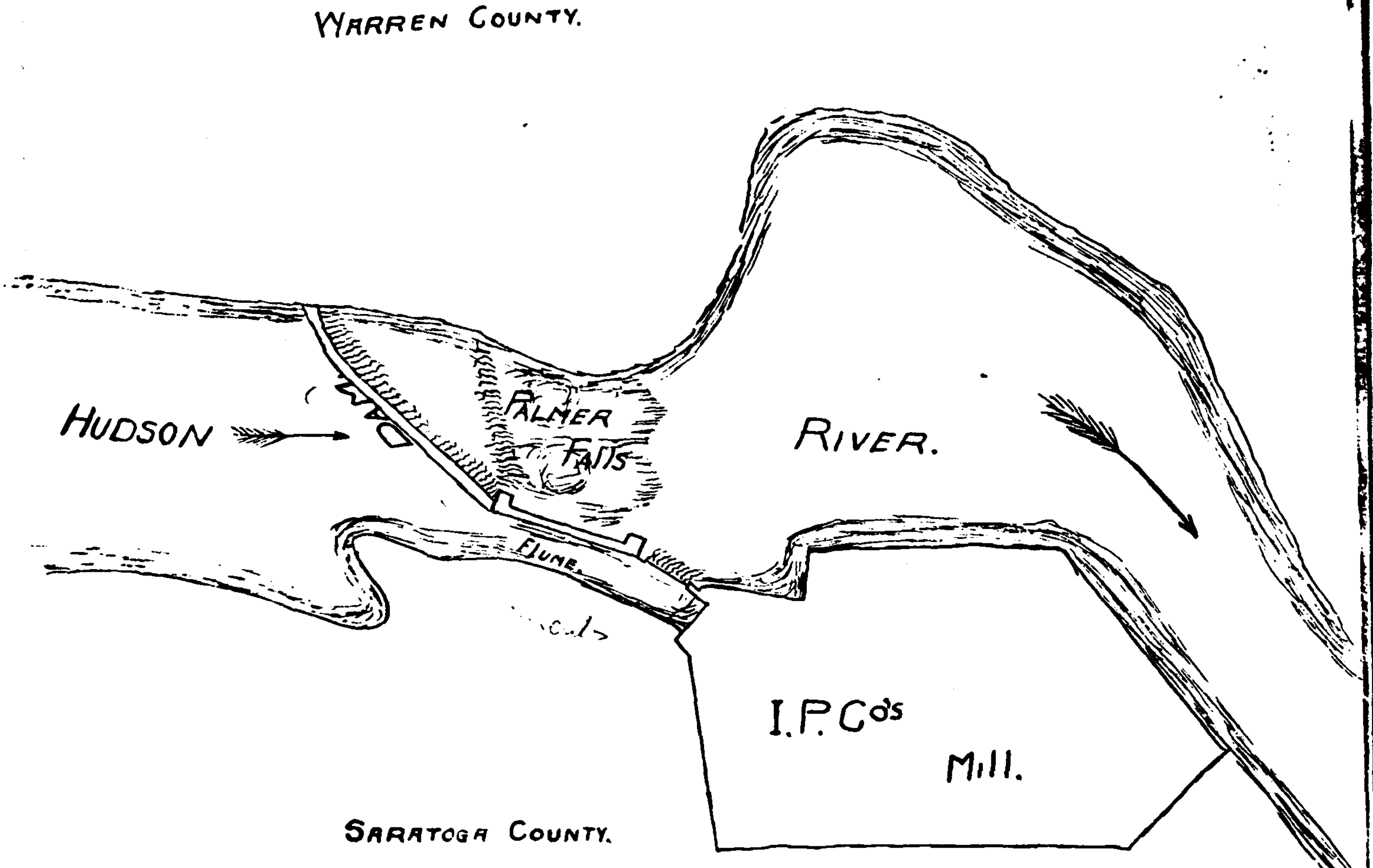
Below sketch section of waste and section of dam, with greatest heights and top thickness and bottom thickness. On opposite side sketch general plan of dam and give distance from a bridge or from a tributary stream.

Plan of the dam filed with Conservation Commission Dam #360

Nearest town Corinth, N.Y.

Received Jan 25
Referred Com'n Moore
[illegible] Secretary

(Signature, address and date.)



WARREN COUNTY.
HUDSON
DAM
PALMER FALLS
RIVER.
FLUME.
I.P. Co's Mill.
SARATOGA COUNTY.

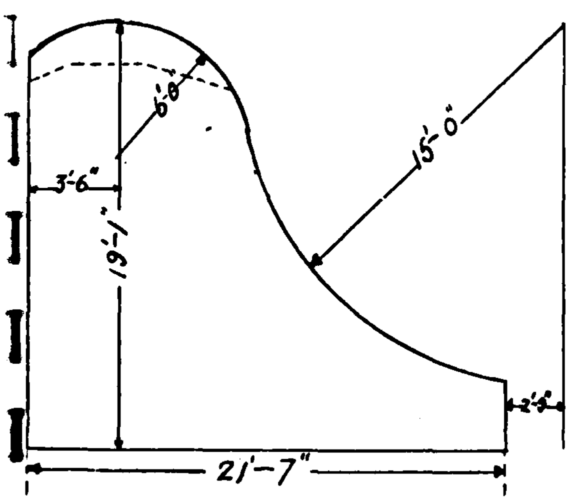
18 30-11 3000 (16-10662)

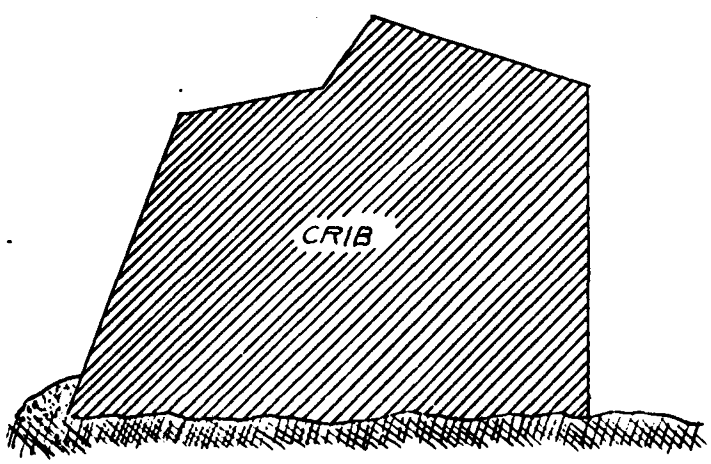
Fill out a form as complete as possible for each dam in your district and send to State Conservation Commission, Albany, N. Y.

1. Name and address of owners International Paper Company
2. Date of construction
3. Uses of impounded water Power for manufacturing pulp and paper
4. Character of foundation bed Ledge
5. Material of waste spill
6. Length of waste and depth below dam
7. Total length of dam including waste [illegible] feet
8. Material of dam [illegible] crib (87½ feet masonry)
9. Discharges, size and location

Below sketch section of waste and section of dam, with greatest heights and top thickness and bottom thickness. On opposite side sketch general plan of dam and give distance from a bridge or from a tributary stream.

Nearest town Palmer

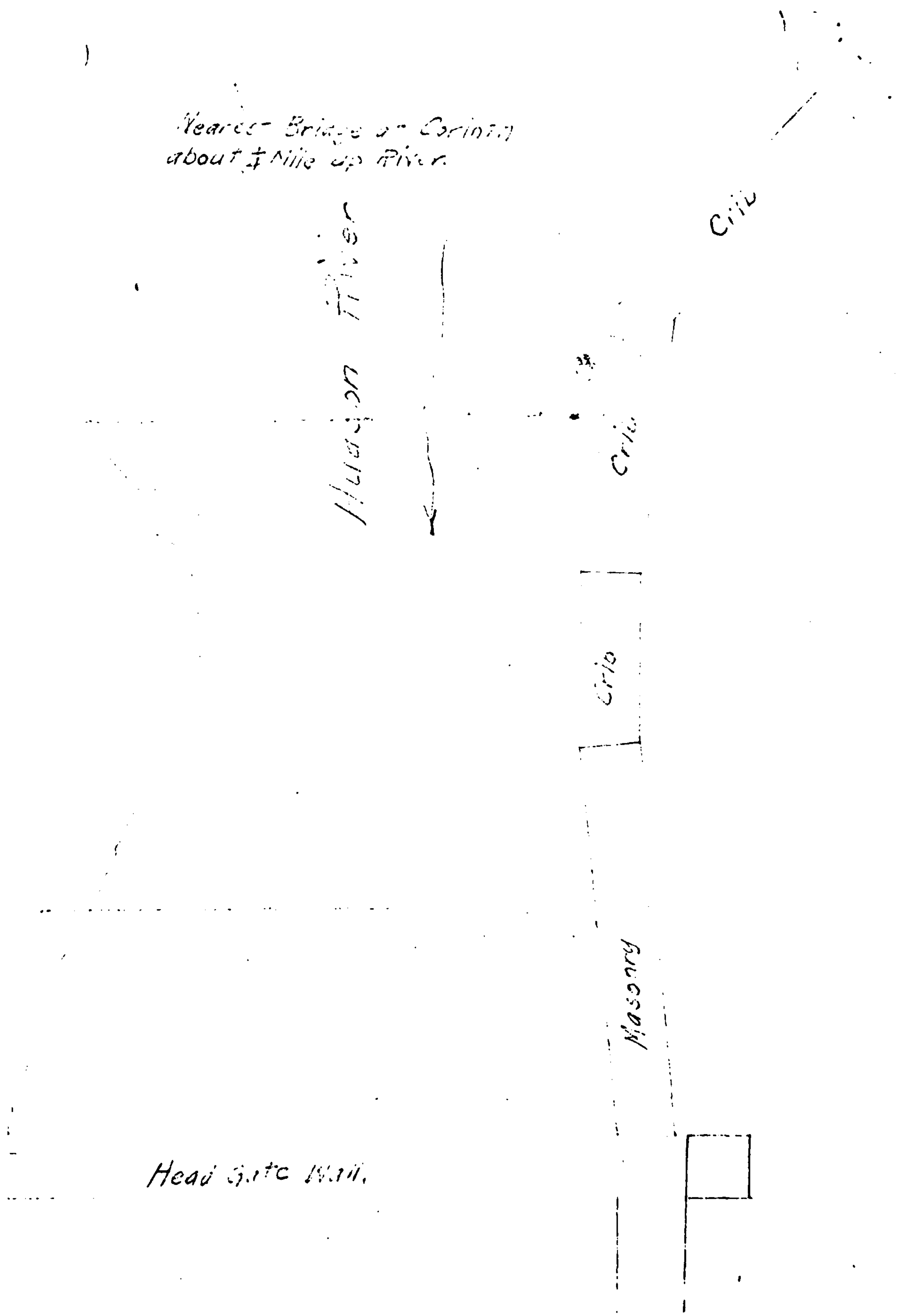




International Paper Company, Mr. Allen Curtis, Manager.

(Signature, address and date.)

April 2nd, 1912.

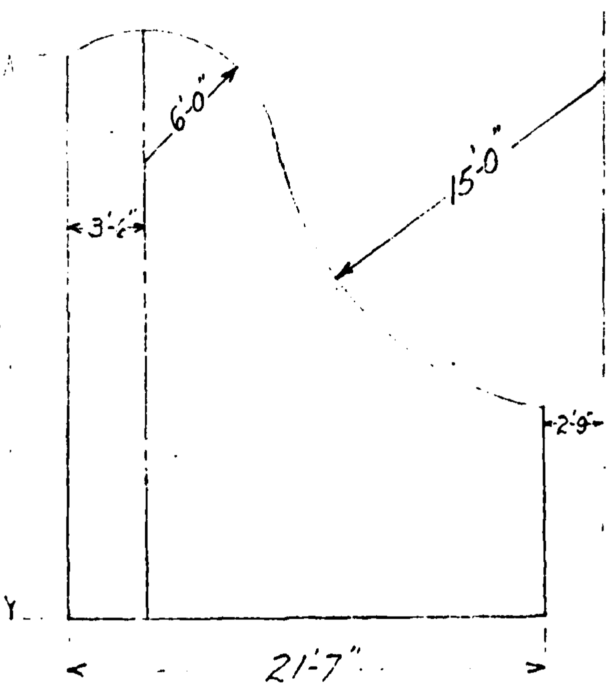

Nearest Bridge at Corinth
about ¼ Mile up River.
Hudson River
Crib
Crib
Crib
Masonry
Head Gate Wall.

18-90,11-3000 (16-10052)

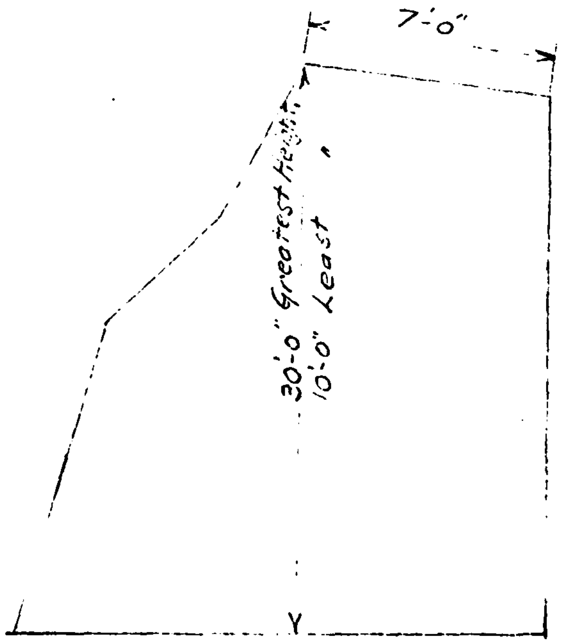
Fill out a form as complete as possible for each dam in your district and send to State Conservation Commission, Albany, N. Y.

1. Name and address of owners [illegible]
2. Date of construction 1881
3. Uses of impounded water [illegible]
4. Character of foundation bed Rock
5. Material of waste spill
6. Length of waste and depth below dam
7. Total length of dam including waste 590 ft.
8. Material of dam Stone Masonry & Earth
9. Discharges, size and location

Below sketch section of waste and section of dam, with greatest heights and top thickness and bottom thickness. On opposite side sketch general plan of dam and give distance from a bridge or from a tributary stream.



Section of Masonry Dam.



Section of Earth Dam.

Nearest town [illegible], N.Y.

(Signature, address and date.)

[illegible] 11-1[illegible]

REPORT ON COMPLETION OF WORK

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany..

On..I inspected the above work and found that it had been completed in a satisfactory manner.

Approved:

....
Inspector of Docks and Dams.

....
Chief Engineer.

INSTRUCTIONS TO APPLICANTS

Requirements for Plans.—Before beginning the construction, reconstruction, alteration or extension of a structure for impounding water, the owner of the proposed structure shall submit, in duplicate, to the Conservation Commission complete drawings showing the location of the dam, the flow line of the impounded water, the boundary lines and the ownership of the property affected, the nature of the foundation bed, the character of the materials to be employed, the size and the location of the discharge and control gates, the general and special features of the dam, and such dimensions as are necessary for the calculation of the stresses and the erection of the structure.

Drawings shall be on sheets of uniform size 24 inches wide by 36 inches long. Each sheet shall have a white space 2¾ inches high by 5½ inches long below the title to receive the stamp of approval. On each sheet of every set of drawings there shall be clearly printed a conspicuous title in which shall appear the name of the county, the name of the city, village or town, and the name of the stream in which the dam is located, and the name of the owner thereof. The scale of the drawings shall be stated under the title. When the designs have been approved by the Commission, one set will be returned to the owner, with such approval endorsed thereon. Copies in duplicate of the specifications under which the dam is to be constructed shall accompany the plans.

Inspection.—The name of the inspector and a statement of his experience in such work must be sent to the Commission. There must also be sent a sample of at least one-half a cubic foot of sand and of cement, and twenty cubic inches of the stone for concrete or masonry to be used in the structure, and of the natural materials in the foundation bed. The foundation bed, after it has been cleared and prepared, must be inspected subject to approval by the Inspector of the Commission. The inspection of materials takes about ten days in the laboratory. On request tags will be sent for labeling the materials.

APPROVAL BY COMMISSION

STATE OF NEW YORK
CONSERVATION COMMISSION
ALBANY

On Sept 2 1913 the Conservation Commission, by resolution duly adopted, approved of the above application for the { ~~construction~~ / reconstruction } of dam 361 Up Hudson on Hudson River and hereby gives permission for the { ~~construction~~ / reconstruction } of said dam within six months from date in accordance with the specifications and plans, and subject before erection to the approval by the Inspector of the materials of construction and of the foundation bed when stripped and prepared, and subject to the inspection of the work during and after construction. This approval may be amended if deemed necessary to secure a safe structure.

(Seal)

[illegible signature]
Secretary to Commission.

REPORT ON INSPECTION OF FOUNDATION

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany....................

Work on the above dam was started...................., contracts for the same having been awarded to....................

....

On....................

....

....

....

Approved:

....
Inspector of Docks and Dams.

....
Chief Engineer.

Sheeting or other cut-off..

Is fishway provided? None

General description of regulating works, gate houses, outlet pipes, penstocks, forebays, canals, flashboards, gates, log chutes, etc.

Names of owners of property which will be submerged by construction of dam, with approximate submerged area owned by each.

It is intended to complete work covered by this application by Nov. 1, 1913
(Date)

REPORT UPON APPLICATION

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany Aug 19 - 1913

I have carefully examined the plans of the above dam, and find that if the work is constructed in accordance with the plans, filed Aug 18 - 1913 with good workmanship and the specified materials that it will be safe.

Approved:

R W Sherman
Chief Engineer.

Alex Rice McKim
Inspector of Docks and Dams.

Masonry or timber portion: See drawing

Length on top .... feet.

Length in stream bed .... feet.

Maximum height above stream bed .... feet.

Maximum height above foundation bed .... feet.

Maximum width of base .... feet.

Maximum width of top .... feet.

Elevation of top above maximum water level in pond .... feet.

Elevation of top above spillway crest .... feet.

Nature of foundations ..... Rock ....

Earth portion:

Embankment: None

Length on top .... feet.

Length in stream bed .... feet.

Maximum height above stream bed .... feet.

Maximum width of base .... feet.

Maximum width of top .... feet.

Elevation of top above maximum water level in pond .... feet.

Elevation of top above spillway crest .... feet.

Slope, upstream face ....

Slope, downstream face ....

Core wall: None

Material ....

Elevation of top above spillway crest .... feet.

Width of top .... feet.

Batter of faces ....

Maximum height above foundations .... feet.

Maximum width of base .... feet.

LOCATION AND GENERAL DATA

Site of dam is on Hudson River
(Name of stream)

a branch of ...., within the
(Name of stream)

limits of the town of Corinth and Luzerne, County of Saratoga and Warren

About 1/4 mile below the bridge between the towns of Corinth and Luzerne
(Give approximate distance from well-known bridge, dam, village or mouth of stream, so that work can be located on map of state)

Purpose of dam holding water to enable the Paper Mill to be operated during the construction of new concrete dam

Reasons for making changes in existing structure part of present Coffer Dam was built in connection with repairing the work in the original timber crib dam. This is to be planked over and made safe to carry next spring's supply. Part of the present structure will be braced on the down stream side in order to withstand next spring's flood.

DATA AND DIMENSIONS

General:

Materials of which dam is to be constructed Timber crib dam, filled with stone and thoroughly ledge pinned

Area of watershed above dam 2760 square miles.

Area of water surface of pond at level of spillway crest 7 acres.

Capacity of reservoir (at above level) about 9,000,000 cubic feet.

Length of spillway crest about 525 feet.

Maximum depth of water on spillway crest .... feet.

Maximum discharging capacity of spillway .... cubic feet per second.

Maximum discharging capacity of spillway per square mile of drainage area .... cubic feet per second.

Form No. 1W86 11-1-12 1000 (6751)

Dam No. 21

GEORGE E. VAN KENNEN, CHAIRMAN
JAMES W. FLEMING
JOHN D. MOORE, COMMISSIONERS
ALBERT E. HOYT, SECRETARY
JOHN J. FARRELL, ASST. SECRETARY

STATE OF NEW YORK

DIVISION OF INLAND WATERS
JOHN D. MOORE, COMMISSIONER
JAMES J. FOX, DEPUTY COMMISSIONER
RICHARD W. SHERMAN, CHIEF ENGINEER
ALEX. RICE MCKIM, INSPECTOR OF DOCKS AND DAMS

CONSERVATION COMMISSION
ALBANY

Serial No. 110

Application filed Aug 18 1913

Approved by Commission Sept 2d 1913

Material Tag No.

Foundations inspected

Final inspection

APPLICATION FOR ~~CONSTRUCTION OR~~ RECONSTRUCTION OF A DAM

No. 30 Broad Street, New York City
(Address of Applicant)

Application is hereby made to the Conservation Commission of the State of New York, in compliance with the provisions of Chap. LXV of the Consolidated Laws, the Conservation Law, for approval of the detailed specifications and plans, marked Sketch showing Coffer Dam at Hudson River at Corinth, N. Y. - No. 3-814 herewith submitted, for the { ~~construction~~ reconstruction } of the dam herein described. All provisions of law will be complied with in the erection of the said dam, whether specified herein or not.

Aug. 18th, 1913
(Date)

{Signature of Applicant} International Paper Co.

Per Geo W Parks VP

REPORT ON COMPLETION OF WORK

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany...

On..I inspected the above work and found that it had been completed in a satisfactory manner.

Approved:

....
Inspector of Docks and Dams.

....
Chief Engineer.

INSTRUCTIONS TO APPLICANTS

Requirements for Plans.—Before beginning the construction, reconstruction, alteration or extension of a structure for impounding water, the owner of the proposed structure shall submit, in duplicate, to the Conservation Commission complete drawings showing the location of the dam, the flow line of the impounded water, the boundary lines and the ownership of the property affected, the nature of the foundation bed, the character of the materials to be employed, the size and the location of the discharge and control gates, the general and special features of the dam, and such dimensions as are necessary for the calculation of the stresses and the erection of the structure.

Drawings shall be on sheets of uniform size 24 inches wide by 36 inches long. Each sheet shall have a white space 2¾ inches high by 5¼ inches long below the title to receive the stamp of approval. On each sheet of every set of drawings there shall be clearly printed a conspicuous title in which shall appear the name of the county, the name of the city, village or town, and the name of the stream in which the dam is located, and the name of the owner thereof. The scale of the drawings shall be stated under the title. When the designs have been approved by the Commission, one set will be returned to the owner, with such approval endorsed thereon. Copies in duplicate of the specifications under which the dam is to be constructed shall accompany the plans.

Inspection.—The name of the inspector and a statement of his experience in such work must be sent to the Commission. There must also be sent a sample of at least one-half a cubic foot of sand and of cement, and twenty cubic inches of the stone for concrete or masonry to be used in the structure, and of the natural materials in the foundation bed. The foundation bed, after it has been cleared and prepared, must be inspected subject to approval by the Inspector of the Commission. The inspection of materials takes about ten days in the laboratory. On request tags will be sent for labeling the materials.

APPROVAL BY COMMISSION

STATE OF NEW YORK

CONSERVATION COMMISSION

ALBANY

On .... the Conservation Commission, by resolution duly adopted, approved of the above application for the { construction / reconstruction } of dam 361 Upper Hudson on Hudson River .... and hereby gives permission for the { construction / reconstruction } of said dam within eighteen months from date in accordance with the specifications and plans, and subject before erection to the approval by the Inspector of the materials of construction and of the foundation bed when stripped and prepared, and subject to the inspection of the work during and after construction. This approval may be amended if deemed necessary to secure a safe structure.

(Seal)

[signature]
Secretary to Commission.

REPORT ON INSPECTION OF FOUNDATION

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany ....

Work on the above dam was started ...., contracts for the same having been awarded to ....

....

On July 2d 1913 I inspected the Foundations. Same were satisfactory and will be sufficient if instructions regarding pockets be carried out. North of angle in dam 3' deep shoulders to be cut for first two piers and pockets for the third

Approved:

Alex Rice McKim
Inspector of Docks and Dams.

....
Chief Engineer.

Sheeting or other cut-off.........

Is fishway provided? No

General description of regulating works, gate houses, outlet pipes, penstocks, forebays, canals, flashboards, gates, log chutes, etc.

See drawings

Names of owners of property which will be submerged by construction of dam, with approximate submerged area owned by each.

It is intended to complete work covered by this application by Oct 1st 1913 (Date)

REPORT UPON APPLICATION

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany July 14th 1913

I have carefully examined the plans of the above dam, and find that if the work is constructed in accordance with the plans, filed July 14th 1913 with good workmanship and the specified materials that it will be safe.

Approved:

[signature] Chief Engineer.

Alex Rice McKim Inspector of Docks and Dams.

Masonry or timber portion:

Length on top .... None .... feet.

Length in stream bed .... feet.

Maximum height above stream bed .... feet.

Maximum height above foundation bed .... feet.

Maximum width of base .... feet.

Maximum width of top .... feet.

Elevation of top above maximum water level in pond .... feet.

Elevation of top above spillway crest .... feet.

Nature of foundations ....

Earth portion:

Embankment: None

Length on top .... feet.

Length in stream bed .... feet.

Maximum height above stream bed .... feet.

Maximum width of base .... feet.

Maximum width of top .... feet.

Elevation of top above maximum water level in pond .... feet.

Elevation of top above spillway crest .... feet.

Slope, upstream face ....

Slope, downstream face ....

Core wall: None

Material ....

Elevation of top above spillway crest .... feet.

Width of top .... feet.

Batter of faces ....

Maximum height above foundations .... feet.

Maximum width of base .... feet.

LOCATION AND GENERAL DATA

Site of dam is on Hudson River
(Name of stream)

a branch of ...., within the
(Name of stream)

limits of the town of Corinth and Luzerne, County of Saratoga & Warren

(Give approximate distance from well-known bridge, dam, village or mouth of stream, so that work can be located on map of state)

Village of Corinth, Palmer Falls

Purpose of dam Power

Reasons for making changes in existing structure Old wood crib dam was partially destroyed during March 1913 flood

DATA AND DIMENSIONS

General:

Materials of which dam is to be constructed Concrete

Area of watershed above dam 2760 ± square miles.

Area of water surface of pond at level of spillway crest 300 000 Sq ft ± ~~acres~~.

Capacity of reservoir (at above level) .... cubic feet.

Length of spillway crest 383 ± feet.

Maximum depth of water on spillway crest 16 ± feet.

Maximum discharging capacity of spillway 90 000 ± cubic feet per second.

Maximum discharging capacity of spillway per square mile of drainage area .... cubic feet per second.

2

Form No. 1W46 [illegible]

Dam No. 261 JH

GEORGE E. VAN KENNEN
CHAIRMAN
JAMES W. FLEMING
JOHN D. MOORE
COMMISSIONERS
ALBERT E. HOYT
SECRETARY
JOHN J. FARRELL
ASST. SECRETARY

STATE OF NEW YORK

DIVISION OF INLAND WATERS
JOHN D. MOORE
COMMISSIONER
JAMES J. FOX
DEPUTY COMMISSIONER
RICHARD W. SHERMAN
CHIEF ENGINEER
ALEX. RICE MCKIM
INSPECTOR OF DOCKS AND DAMS

CONSERVATION COMMISSION
ALBANY

Serial No. 93

Application filed July 14th 1913

Approved by Commission

Material Tag No.

Foundations inspected July 2d 1913

Final inspection

APPLICATION FOR CONSTRUCTION ~~OR RECONSTRUCTION~~ OF A DAM

30 Broad St. N.Y. City
(Address of Applicant)

Application is hereby made to the Conservation Commission of the State of New York, in compliance with the provisions of Chap. LXV of the Consolidated Laws, the Conservation Law, for approval of the detailed specifications and plans, marked 3-792 and 3-814

herewith submitted, for the {construction ~~reconstruction~~} of the dam herein described. All provisions of law will be complied with in the erection of the said dam, whether specified herein or not.

July 1st 1913
(Date)

{Signature of Applicant} International Paper Company
By [illegible]
President

Form 209

THE WESTERN UNION TELEGRAPH COMPANY

INCORPORATED

Copy

25,000 OFFICES IN AMERICA. CABLE SERVICE TO ALL THE WORLD

THEO. N. VAIL, PRESIDENT BELVIDERE BROOKS, GENERAL MANAGER

RECEIVER'S No.	TIME FILED	CHECK
		174 Pd

SEND the following message subject to the terms on back hereof, which are hereby agreed to

Lake George, N. Y., Aug. 6/13.

Hon. John D. Moore,
C/o R. H. Burpee,
Rockland, Maine.

With Perkins and Chief Engineer White have just inspected Palmer Falls dam site and plans. Still consider proposed construction and site combined as hazardous, and cannot approve thereof. I desire to employ three outside experts to examine and report, and request that you inspect in person with them and myself. Will be back in Albany this evening. Please wire instructions.

RUSH

R. W. SHERMAN.

CRESCENT BEACH PHILBROOK STAR ROUTE ROCKLAND MAINE THE LETTER WILL REACH ME BY SIX THIRTY FRIDAY EVENING AND I WILL TELEGRAPH YOU REPLY IMMEDIATELY.

JOHN D MOORE

221AM

1913

ON INLAND WATERS

Chief Engineer

THEO. N. VAIL, PRESIDENT

RECEIVED AT [illegible] N. Y.

72 J 84COLLECT NL VIA ROCKLAND

CRESCENT BEACH MAINE AUG 6

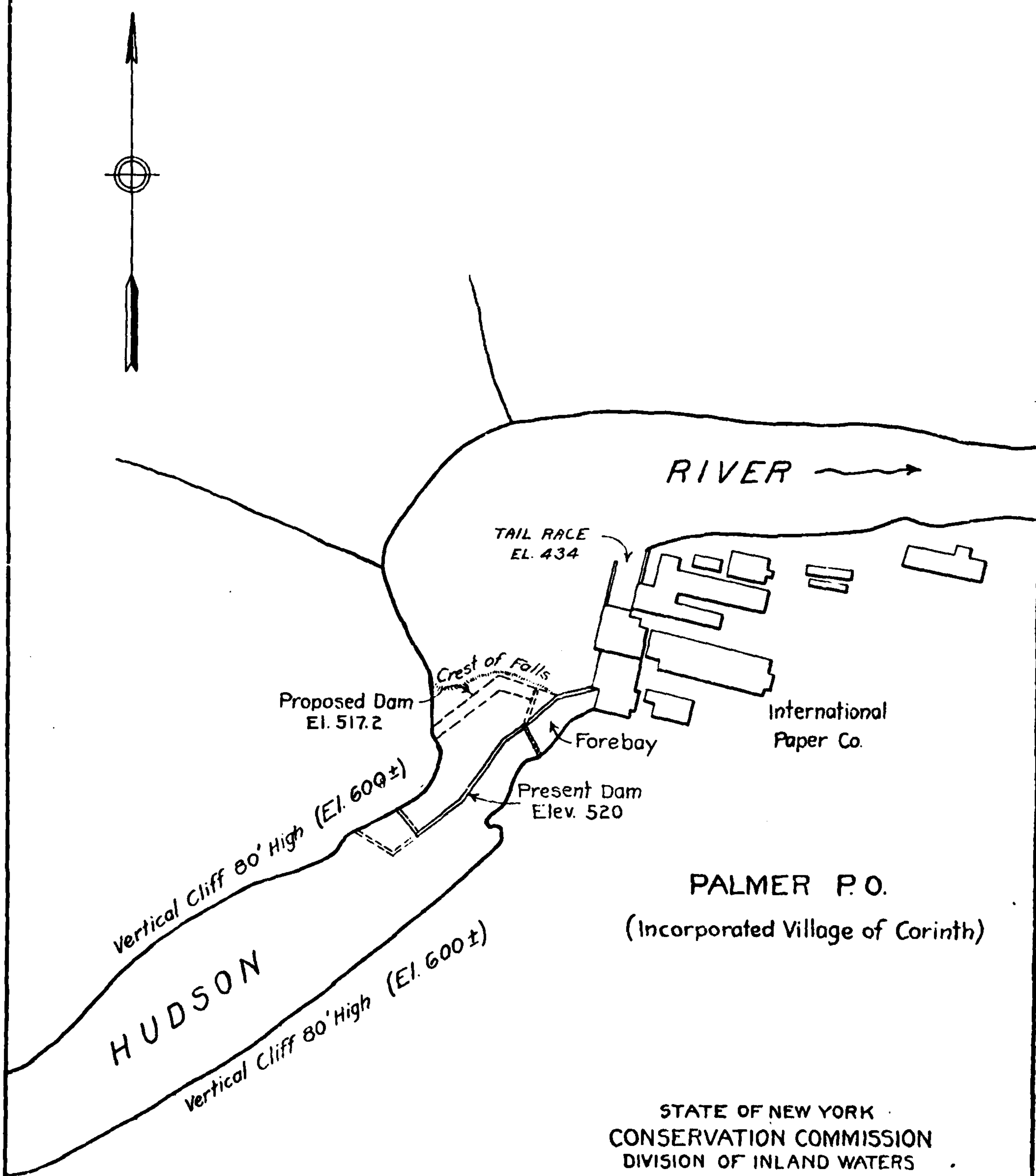
MICHAEL W SHERMAN CHIEF ENGINEER CONSERVATION COMMITTEE ALBANY

TELEGRAM RECEIVED SUBJECT PALMERS FALLS AM OPPOSED TO SUGGESTED PLAN TO BRING IN OUTSIDE ENGINEERS THE LAW MAKES APPROVAL OF PLANS BY [illegible] AND THEREFORE RESPONSIBILITY IS PLACED DIRECTLY UPON THE COMMITTEE [illegible] TO [illegible] THE [illegible] OF PLANS WHICH [illegible] SATISFACTORY IN EVERY RESPECT AND SEE TO IT THAT CONSTRUCTION WORK IS INSTANTLY DISCONTINUED IF YOU WILL WRITE ME FULLY TOMORROW TO CRESCENT BEACH PHILBROOK STAR ROUTE ROCKLAND MAINE THE LETTER WILL REACH ME BY SIX THIRTY FRIDAY EVENING AND I WILL TELEGRAPH YOU REPLY IMMEDIATELY.

JOHN D MOORE

221AM

File Nº D 503-4 H
Acc 2056

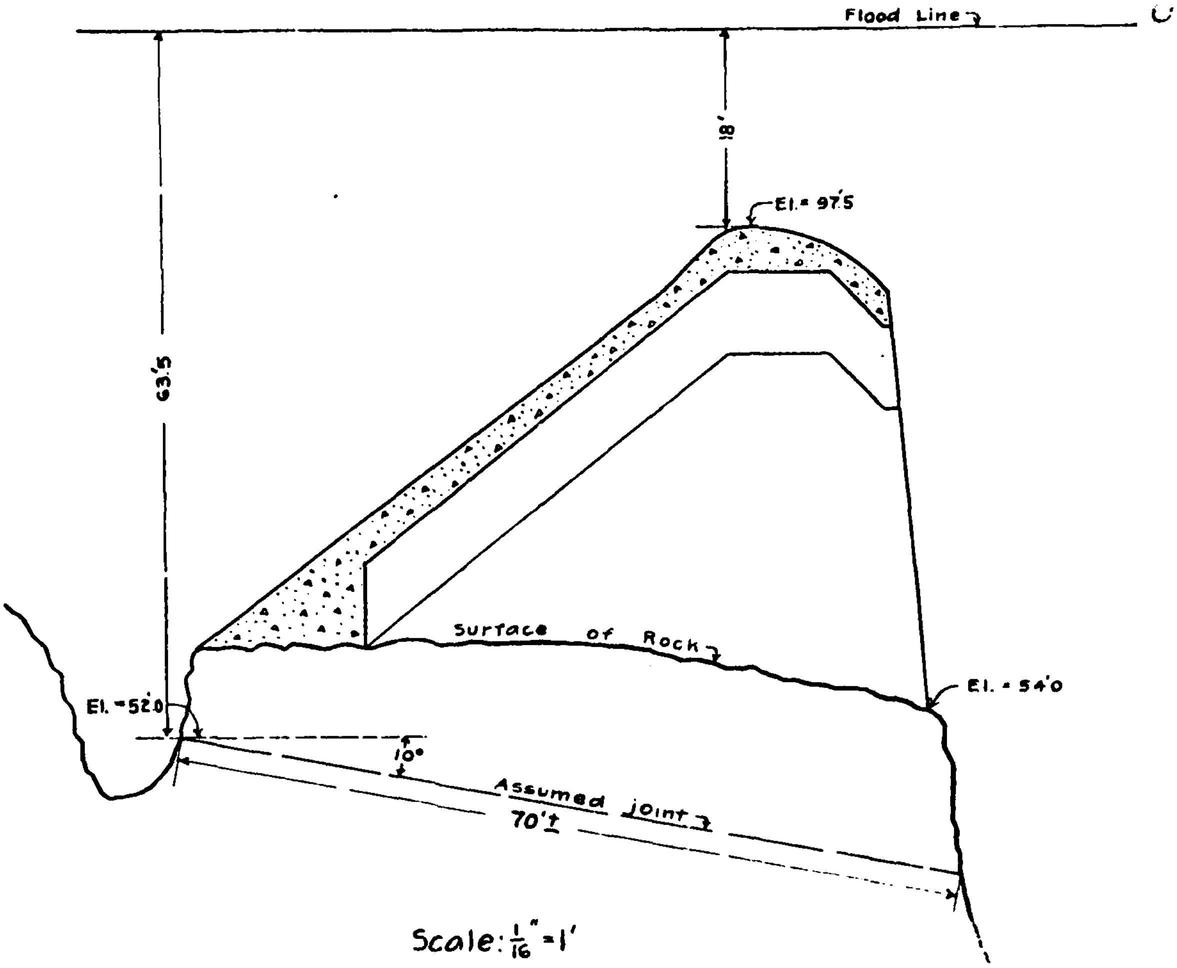


STATE OF NEW YORK
CONSERVATION COMMISSION
DIVISION OF INLAND WATERS

SKETCH SHOWING LOCATION OF PRESENT AND PROPOSED DAMS AT PALMER FALLS

AUG. 1913 SCALE 1" = 400'

R. H. Sherman CHIEF ENG'R.



Scale: $\frac{1}{16}$" = 1'

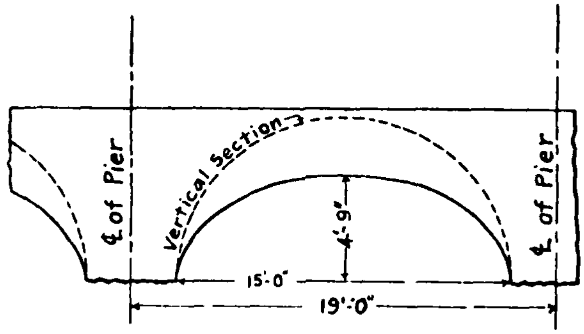
Total vertical load on assumed joint	[illegible] 000*
Upward pressure of water (assuming full [illegible] pressure at heel, decreasing uniformly to zero at toe, effective over two-thirds area of base)	= 1 760 000*
Net vertical load	= 4 830 000*
Horizontal component of water pressure	= 2 200 000*
Total pressure parallel to joint	= 3 005 000*
" " perpendicular to joint	= 4 378 000*
Coefficient of friction	= 0.69

STATE OF NEW YORK
CONSERVATION COMMISSION
DIVISION OF INLAND WATERS

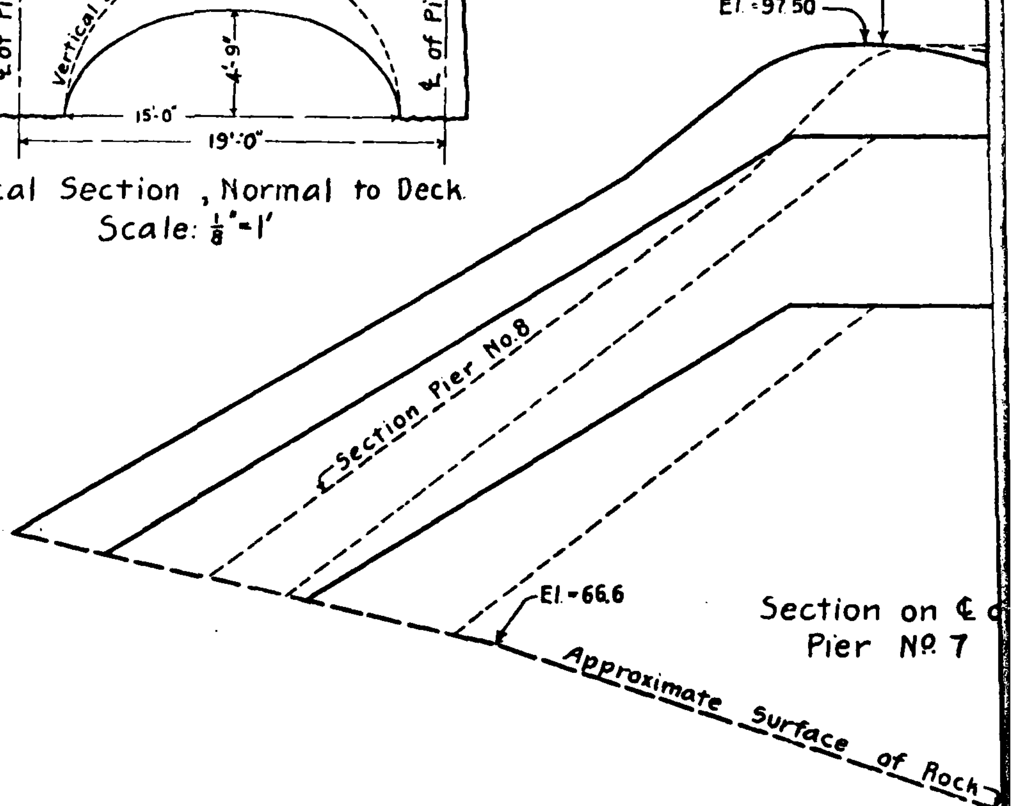
PALMER FALLS DAM

SKETCH SHOWING EFFECT OF WATER PRESSURE IN JOINT UNDER DAM

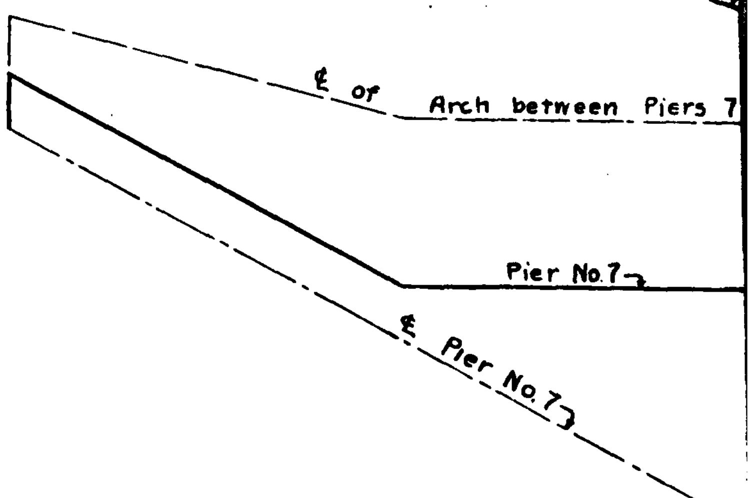
Computed by: E. S. Cullings Checked by: H. P. Gillespie Aug 12, 1913.
Acc. No. C-356 File No. D [illegible]



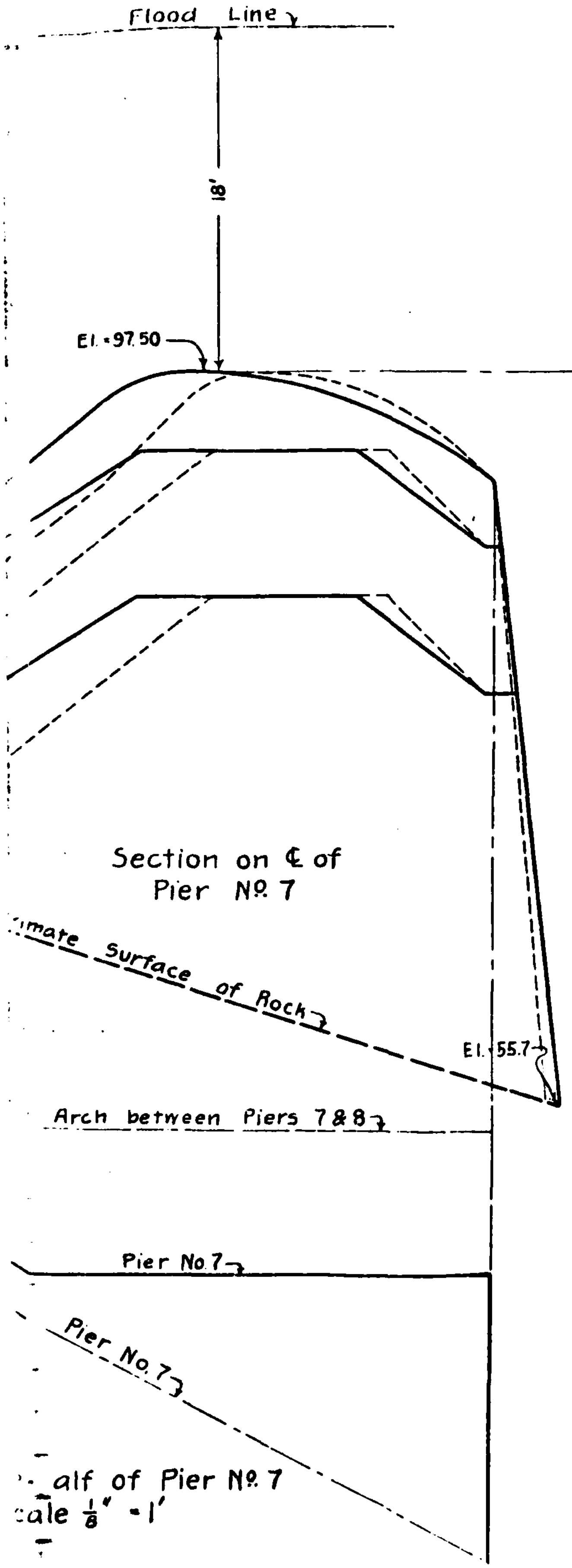
Typical Section, Normal to Deck.
Scale: $\frac{1}{8}$" = 1'



Section on ℄ of
Pier No. 7



Plan, One-half of Pier No. 7
Scale $\frac{1}{8}$" = 1'



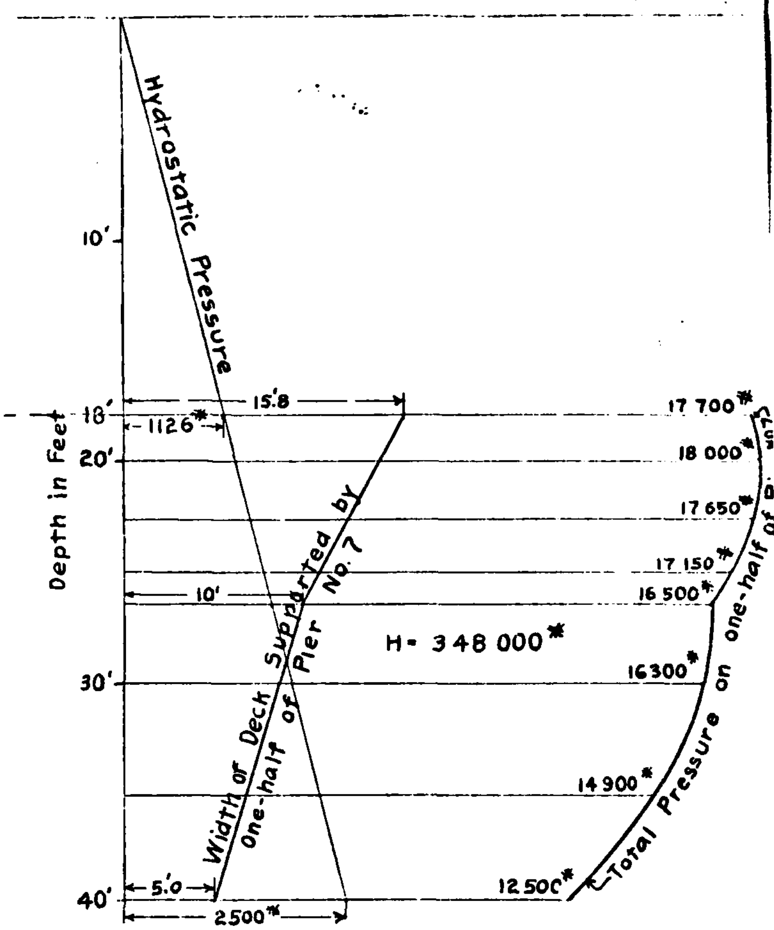


Diagram Showing Horizontal Load on One-half of Pier No. 7

STATE OF NEW YORK

CONSERVATION COMMISSION

DIVISION OF INLAND WATERS

SKETCH SHOWING CONDITIONS AT PIER

PALMER FALLS DAM

NOTE: Elevations shown are referred to I.P.C

Computed by E. ... Checked by

Acc. No. C-355 Aug. 12, 1913 File No. F

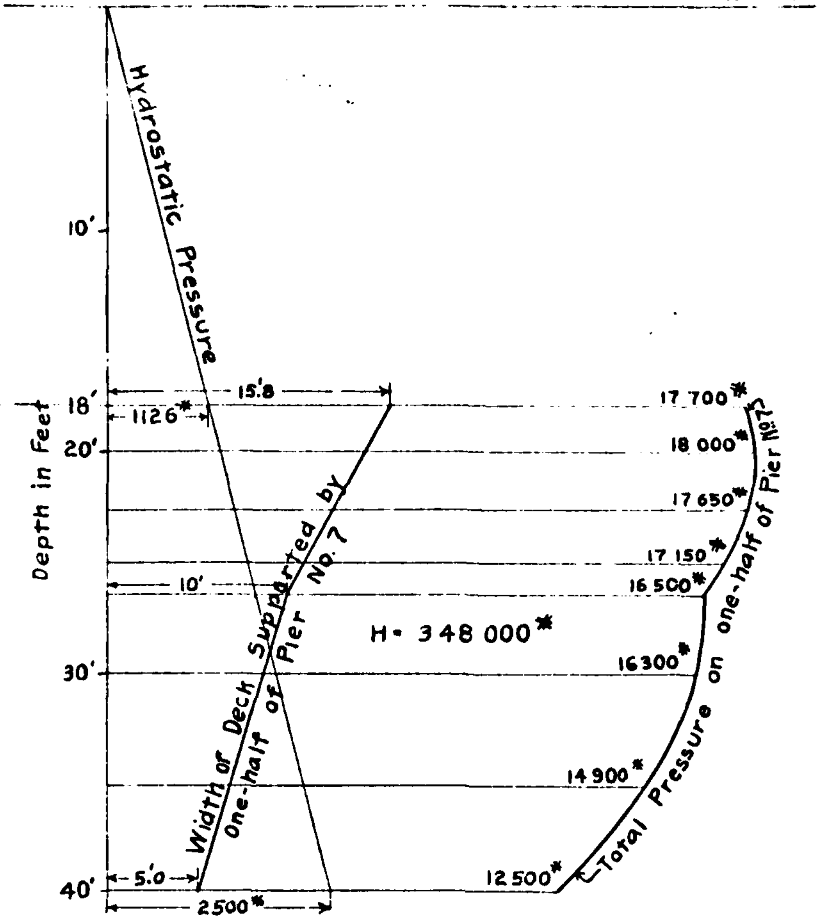


Diagram Showing Horizontal
Load on One-half of Pier No. 7

STATE OF NEW YORK
CONSERVATION COMMISSION
DIVISION OF INLAND WATERS
SKETCH SHOWING CONDITIONS AT PIER No. 7
PALMER FALLS DAM

NOTE: Elevations shown are referred to I.P.Co's datum.

Computed by ______ Checked by ______
Acc. No. C-355 Aug 12, 1913 File No. D ______ H

Subject: Palmer Falls Dam.
Stability of proposed section

File No. [illegible]
Acc. No. [illegible]
Sheet

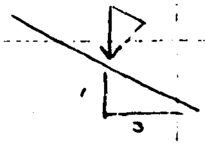
Computer: R. [illegible] Aug. 1913 Checked by ________ 19

Made in connection with: Report Aug 13, 1913

Cont'd from Acc. K 9[illegible]

Assuming long standing crack.

W.t. Rock = 120 × 10 × 19 × 145 = 3 360 000
W.t. Dam. & water press. 1 363 000
4 723 000



Slope of seam 40 in 120 = 1 in 3

Comps: Normal $\frac{3}{\sqrt{10}}$ × 4 723 000 = 4 470 000 lbs.
Tang. $\frac{1}{\sqrt{10}}$ = 1 495 000 lbs. 33.4 %

Horiz. water pressure
Dam. = 1 450 000 lbs.
Rock = 58 × 62.5 × 19 × 2/3 × ½ × 40 = 880 000
2 330 000 lbs.

Norm. 2 210 000 lbs.
Tang. 738 000 lbs.

4 470 000
2 210 000
2 260 000

1 495 000
738 000
2 233 000

In which case dam will fail.

STATE NEW YORK CONSERVATION COMMISSION SUBJECT Palmers Falls Dam ~~[illegible]~~ 43 FILE NO. ~~[illegible]~~

Stability of Proposed Section. ACC. NO. K 974

SHEET 2

COMPUTER O. K. Hutin Aug 1913 CHECKED BY 19

MADE IN CONNECTION WITH Report. Aug. 13, 1913

CONT'D FROM ACC. 4973

Weight elements in 19'-5" bay

Pier $\frac{14}{65}$ 79 × ½ = 39.5 × $\frac{95}{60}$ 35 × 4 × 140 = 840 000 lbs.

Triangular sect. 15 × ½ × 15 $\frac{9}{12}$ × 15 × 140 = ~~[illegible]~~ 177 000 lbs.

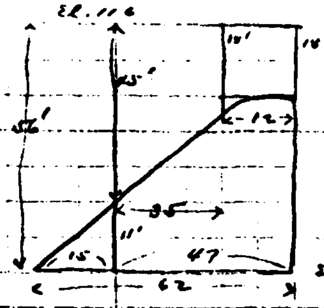
Slab $\frac{5}{2}$ × 41 × 15 × 140 = 215 000 — $\frac{62}{15}$ 47

18 × 3 × 15 × 140 = 113 200

15² = 225; 150 − 177 = 48; 20 × 58 × 140 = 195 000

523 000 — 840 000 — 1 363 000

Wt. masonry in one pair — 523 000 / 1,363,000 lbs. = 1 363 000 / 47 = 29 000 lbs. per ft.



Vert. & Horiz. Water Press.

Vert. in Slab. = 14 × 19 × 62.5 × 12 = 256 000 lbs.

(14+45) 63 × ½ × 35 × 19 × 62.5 = 1 310 000 lbs.

Δ Sect. 45+56 = 101 × ½ × 15 × 19 × 62.5 = 893 000 lbs.

Hor. Slab. 1 310 000 × $\frac{11}{15}$ = 963 000 lbs.

Δ Sect. 893 000 × $\frac{11}{15}$ = 655 000 lbs.

Vert. pressure Δ sect. 56 × 62.5 × ⅔ × 15 × ½ × 15 = 262 000 lbs.

Vert. pressure pier 56 × 62.5 × ⅔ × 62 × ½ × 4 × 1/4 = 75 000 lbs.

(14+56) = 64 × ½ × 62.5 × 34 × 19 — 337 000

V_e: 256 000; 1 310 000; 893 000; 1 363 000; 3 822 000; 337 000; 3,485,000 lbs.

H_o: ~~963 000~~; ~~655 000~~; ~~1,618,000~~ lbs.; 1 450 000

3 485 000 / 1 450 000 = ~~2.15~~ — F: ~~0.464~~ 41.6 %

56 × 62.5 = 3500 lbs. per □ ft. = 24 ft. rock

Assume 6 ft. thickness of rock 100 ft. long.

Vert. press. = 100 × 19 × 56 × 62.5 = 6 650,000 lbs.

− 100 × 19 × 62 × 62.5 × ⅔ = 2 460 000 lbs.

4 190,000 lbs.

Rock = 100 × 19 × 6 × 145 = 1 800 000 lbs.

Masonry = 1 363 000 lbs.

Total 7 353 000 lbs.

Horiz. press.

Masonry ~~1 450 000~~ 1 450 000 lbs.

Rock (56+62) f = 118 × ½ × 19 × 6 × 62.5 = 360 000 lbs.

1 810 000 lbs. 24.6 %

~~V_e = 3 485 000 lbs.~~ H_o = 1 450 000

Area = 62 × 4 = 248 □ ft. Shear = 5850 lbs. per □ ft. = ~~[illegible]~~ lbs. □" 40.5 lbs. □"

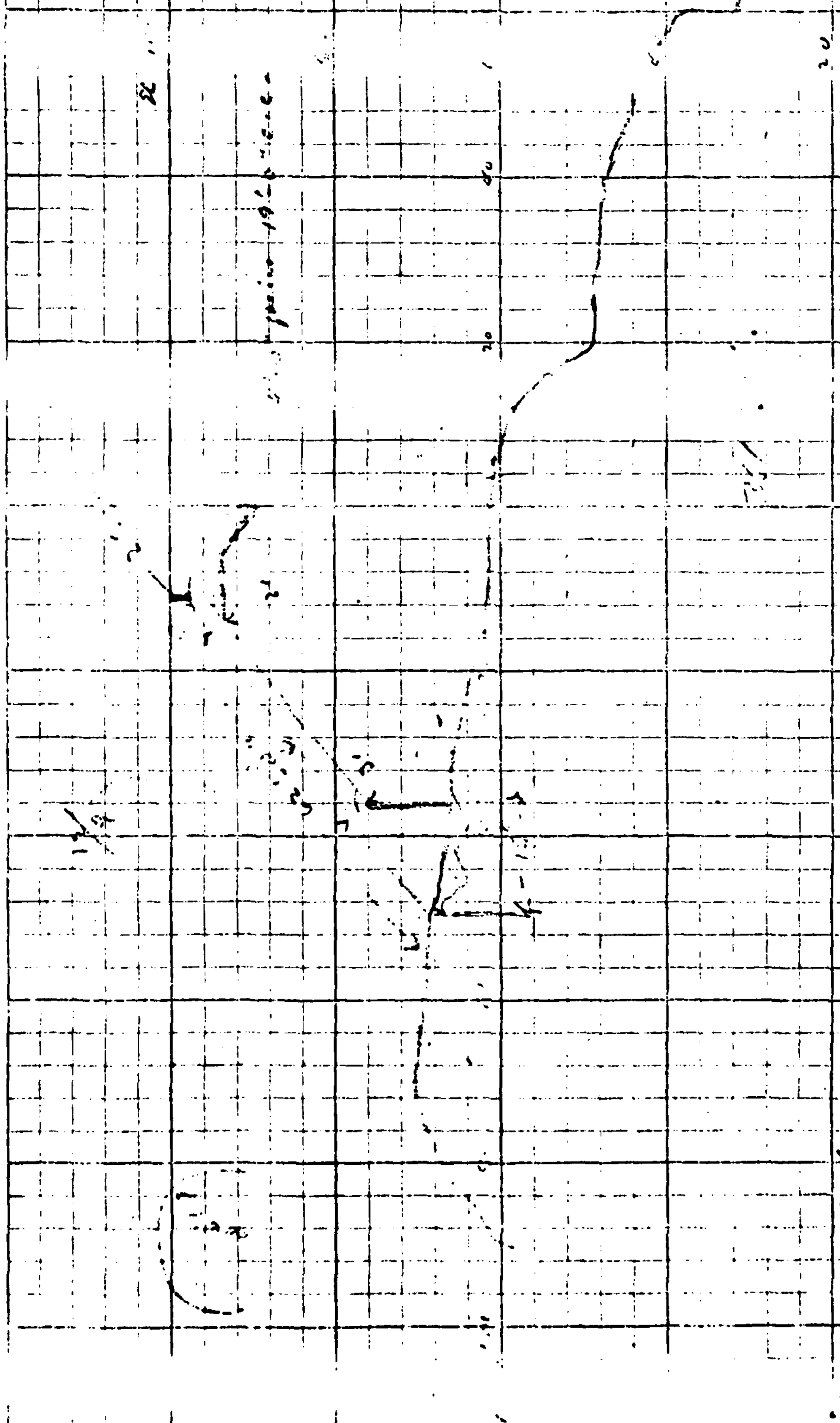
SUBJECT Palmers Falls Dam
Stability of proposed section

FILE NO. [illegible]
ACC. NO. [illegible]
SHEET 1

COMPUTER O.P. Hertz Aug 1913 CHECKED BY ______ 19__

MADE IN CONNECTION WITH Rept Aug 19, 1913

CONT'D FROM ACC. ______



Spillway 376 ft. long
Max. discharge 100,000 sec. ft. total
" " 266 sec. ft. per ft.
" " 18 ft. on spillway crest.

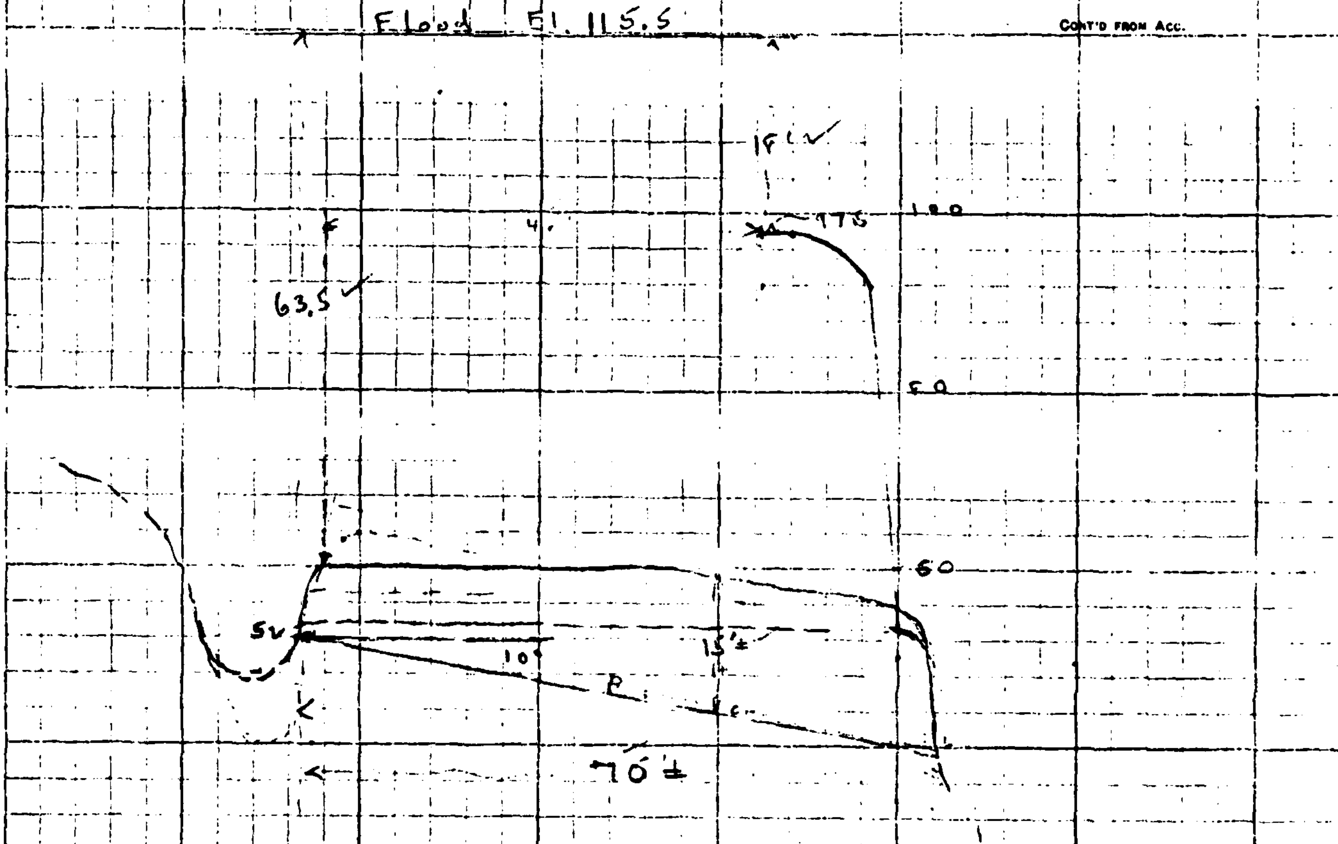
SUBJECT [illegible] FILE NO. [illegible]

ACC. NO. C-[illegible]

SHEET 1

COMPUTER [illegible] Aug 11 19[illegible] CHECKED BY [illegible] 19[illegible]

MADE IN CONNECTION WITH



Vertical Load

Water: $V = \frac{\gamma l}{2}(h+d) = \frac{62.5 \times 48}{2}(17+54.5) \times 19 = 2,070,000$ #

Masonry (c-344) 10467 × 145 = 1,520,000

Rock (×70×15 − 35 × 7/2) × 19 × 170 = 3,000,000

Total 6,590,000 #

Upward water pressure

$\gamma \cdot 63.5 \times \frac{2}{3} \times \frac{1}{2} \times 70 \times 19$ = − 1,760,000

Net Vertical Load = 4,830,000 #

Horizontal Water Pressure

$H = \frac{\gamma \times 45.5}{2}(17+63.5) \times 19$ = = 2,200,000

H = 2,200,000

H cos 10° = + 2,165,000 #

Total H [illegible]

H sin 10° = − [illegible]

V cos 10° = + [illegible]

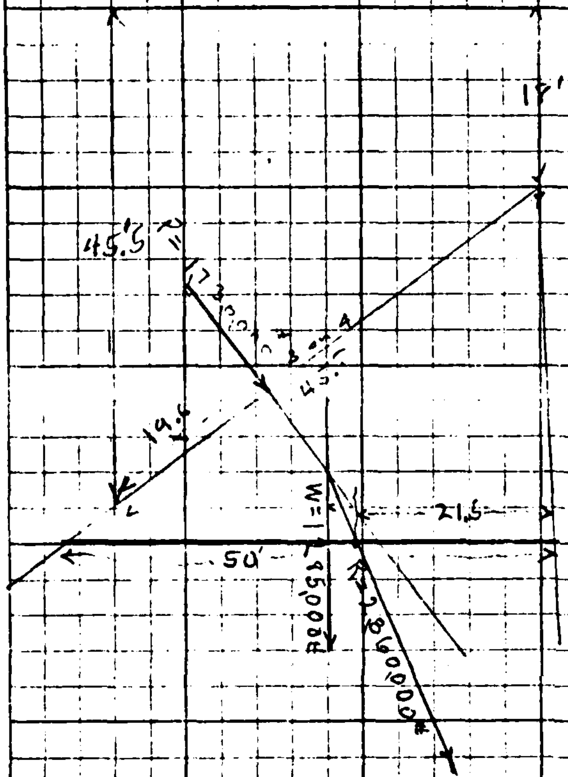
[illegible] 4,780,000

SUBJECT Palmer Falls Dam — FILE NO D-5… — ACC. NO C-353

SHEET ……

COMPUTER ……… Aug 11 1913 CHECKED BY ……… 19 …

MADE IN CONNECTION WITH — CONT'D FROM ACC.



$P = \frac{wh}{2}(h+d)$

$= \frac{62.5 \times 45.5}{2}\left(45.5 + 18\right) \times 19 =$ (63.5)

$= 1,730,000\#$

$x = \frac{h}{3}\left(\frac{h+2d}{h+d}\right) = \frac{45.5}{3}\left(\frac{81.5}{63.5}\right) = 19.6$

From Plan, resultant cuts base 21.5 from toe.

Eccentricity = 3.5

$\therefore S_t = \frac{R}{l}\left(1 + 6\frac{e}{l}\right)$

$= \frac{\overset{57200}{2860000}}{50}\left(1 + \frac{6 \times 3.5}{50}\right) = 20300\#/\text{sq.ft}$

$= 141\#/\text{sq.in}$

$S_h = \frac{R}{l}\left(1 - 6\frac{e}{l}\right) = 8300\#/\text{sq.ft}$

$= 58\#/\text{sq.in.}$

Stress at heel & toe using vert. force of 1,285,000#

$S_t = \frac{1,285,000}{50}\left(1 + \frac{6 \times 3.5}{50}\right) = 25700 \times 1.42 = 36500$ … #/sq.ft

63 #/sq.in.

$S_h = \frac{1}{4}\frac{R}{l}\left(1 - 6\frac{e}{l}\right) = \frac{1}{4} \times 25700 \times 0.58 = 3730\#/\text{sq.ft.}$

$= 26\#/\text{sq.in.}$

Stress at heel & toe using resultant = 2,860,000#

$S_t = \frac{1}{4} \times \frac{\overset{57200}{2860000}}{50}\left(1 + 6 \times \frac{3.5}{50}\right) = 14300 \times 1.42 = 20300\#/\text{sq.ft}$

$= 141\#/\text{sq.in}$

$S_h = \frac{1}{4} \times 57200 \times 0.58 = 14300 \times 0.58 = 8290\#/\text{sq.ft}$

$= 58\#/\text{sq.in}$

SUBJECT

FILE NO.

ACC. NO. C-352

SHEET

COMPUTER 19 CHECKED BY 19

MADE IN CONNECTION WITH

CONT'D FROM ACC.

$2250 \times \frac{19}{4} = 13500$

See Acc. C-353.

New York Conservation Commission

SUBJECT .... FILE NO. ....

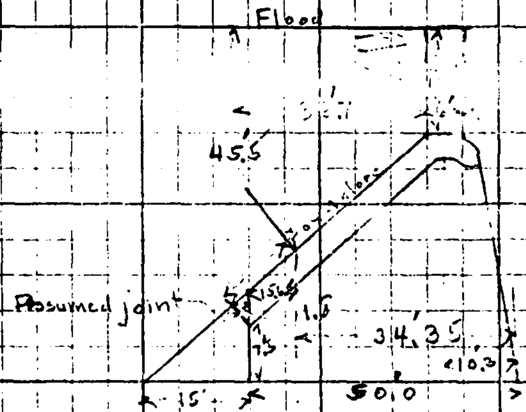
ACC. NO. C-351

SHEET ....

COMPUTER .... 19.... CHECKED BY .... 19....

MADE IN CONNECTION WITH

CONT'D FROM ACC.



Compression on pier (assuming j...

Vert. water pressure on deck

$V = \frac{62.5 \times ...}{2}(18 + 45.5) \times 19 = 1,385,000$

Point of application

$x = \frac{(h+2d)}{3(d+h)} l = \frac{(45.5+36) \times 36.7}{3(18+45.5)} = 15.65$

$50 - 15.65 = 34.35$ from toe

Water pressure on crest — Assumed to exert full vert. pressure over 6 ft. hor.

$\therefore 18 \times 6 \times 19 \times 62.5 = 128300$ #

Acts — $50 - (36.7 + 3) = 10.3$ ft. from toe

Weight of masonry

10467	42704400	moment
1604	12800000	
8863 cu.ft.	29,904,400	

$\frac{29904400}{8863 \times 145} = 23.3$ ft from toe

See Acc. C-353

Resultant Vertical Pressure

Water on deck	1,385,000	× 34.35	=	47600000 ft#
" " crest	128,300	× 10.3	=	1320000 "
Masonry	1,285,000	× 23.3	=	30000000 "
Total	2,798,300#	28.2		78920000 "

$2798300 \left(1 - \ldots\right) = \ldots$ ... $(1 + \ldots) = 19 \ldots$

$= 60 \ldots$

[illegible] YORK [illegible] CONSERVATION COMMISSION

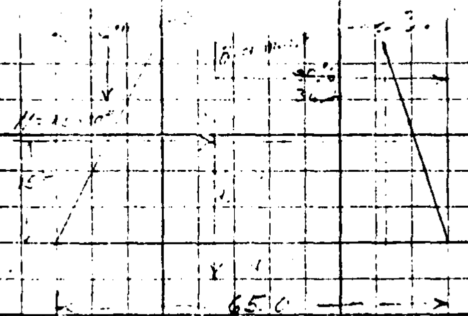
SUBJECT

FILE NO.
ACC. NO. C-350
SHEET

COMPUTER Aug 8 1913 CHECKED BY 19

MADE IN CONNECTION WITH

CONT'D FROM ACC.



Total weight 1,520,000 " "

$x_0 = \frac{42\,700\,000}{1\,520\,000} = 28.1$ ft [illegible]

~~[illegible]~~ = 139,000,000
= 3,695,000

~~[illegible] $\frac{139}{3.70}$ = 37.6 [illegible] = 5.1~~

Tan $\frac{85}{3670}$ = 0.0232 α = 1° 20'

15.5 x [illegible] = 0.36 [illegible] = 5.1 - 0.4 = 4.7

S_{max} (total) = $\frac{W}{b}\left(1+6\frac{e}{b}\right) = \frac{3695000}{65}\left(1+6\frac{4.7}{65}\right) = \frac{3695000}{65} \times 1.433 = 81400$

S_p (per foot) = $\frac{81400}{19}$ = 4280

Vertical [illegible] 9' width of [illegible] 62.5 x 15 x 9 x 19 = 192,500

[illegible] 15 [illegible] 12.5 = 241,000 [illegible]
695 000 137 000 000
[illegible] 1 [illegible]

Superseded by C-353

C [illegible]

SUBJECT Palmer Falls Dam FILE NO. D-5...

ACC. NO. C-345

SHEET 5

COMPUTER ... Aug 5 1913 CHECKED BY ... Aug 1913

MADE IN CONNECTION WITH

CONT'D FROM ACC. C-344

Resisting Moment = 137000000

Overturning " = 55000000

Factor of Safety = 2.5

Sliding on Hor. Plane

Vertical comp. of water, 114300 × 19 = 2,175,000

Wt. of Masonry 10467 × 145 = 1,520,000

Total 3,695,000

Buoyancy 495,000

Net total 3,200,000

Hor. comp. of water, 85800 × 19 = 1,630,000

Coefficient of Friction = 0.68

Allowable " " " = 0.34 (Factor of safety of two)

$\frac{1630000}{3200000} = 0.51$ Too high

$\frac{.68}{.51} = 1.33$ = Actual Factor of Safety

Not considering buoyancy:—

$\frac{1630000}{3695000} = 0.43$ Too high

$\frac{.68}{.43} = 1.58$

Shear — At top of "heel"

$\frac{\frac{18 + 44.5}{2} \times 62.5 \cdot 26.5 \cdot 19}{4 \times 49 \times 144} = 35^{\#}/\text{sq. in}$

Assuming joint in arch at top of "heel" normal to deck

$\frac{\frac{18 + 51.5}{2} \times 69.5 \cdot 33.5 \times 19}{4 \times 44.5 \times 144} = 54^{\#}/\text{sq. in}$

NEW YORK CONSERVATION COMMISSION

SUBJECT Palmer Falls Dam — FILE NO.

Computation of Stresses — ACC. NO. C-344

SHEET

COMPUTER D. ... Aug 5 1913 CHECKED BY H... Aug ... 1913

MADE IN CONNECTION WITH

CONT'D FROM ACC. C-343

Wt. of 19 ft. section. 145# per cu. ft.

Heel

$\frac{15 \times 11.25}{2} \times 19 =$ 1604 cu.ft. lever arm = 55.0

Deck

$\left[\frac{11.25+19.00}{2} \times 19 - \frac{176.7}{2}\right] \times 33 =$ 3750 cu.ft. l = 33.5

Crest

$(11.5 \times 19 - 88.3) \times 9.0 =$ 1170 cu.ft. = 12.5

Apron

$(10.8 \times 19 - 88.3) \times 5.5 =$ 643 cu.ft. 5.25

Pier

Sec A	$33 \times \frac{26}{2} \times 4$	=	1715	28.0
B	$26 \times 9 \times 4$	=	936	12.5
C	$21 \times 6.25 \times 4$	=	525	4.77
D	$21 \times \frac{1.75}{2} \times 4$	=	74	1.17
E	$\frac{5 \times 5}{2} \times 4$	=	50	6.33
			10,467	

Resistance to Overturning

Heel	1604	× 145 ×	55.0	=	12,800,000 Foot-pounds
Deck	3750	× 145 ×	33.5	=	18,200,000
Crest	1170	× 145 ×	12.5	=	2,125,000
Apron	643	× 145 ×	5.25	=	490,000
Pier – A	1715	× 145 ×	28.0	=	6,960,000
B	936	× 145 ×	12.5	=	1,700,000
C	525	× 145 ×	4.77	=	371,000
D	74	× 145 ×	1.17	=	12,600
E	50	× 145 ×	6.33	=	45,800
~~10467~~		× 145 ×			42,704,400
Vert. comp. of Water 11430 × 19 × 44.5					1,630,000
					43,704,400

New York State Conservation Commission

SUBJECT: ... Falls Dam

FILE NO.

ACC. NO. C-343

SHEET

COMPUTER ... Aug 1 1913 CHECKED BY ... Aug 5 1913

MADE IN CONNECTION WITH

CONT'D FROM ACC. C-342

Max. Flood, 100,000 sec. ft.

Length of spillway 376 ft.

Use $Q = CLH^{3/2}$ $C = 3.75$; $L = 376$, $Q = 100000$

$$\therefore H = \left(\frac{100000}{3.75 \times 376}\right)^{2/3} = (71.0)^{2/3}$$

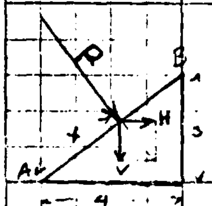
log 71.0 = 1.851258

$3\overline{)3.702516}$

$1.234172 = 17.15$ ft. Call 18 ft.

18' flood on crest, base at el. 60.00, or 37.5 below crest.

$$P = \frac{\gamma l}{2}(h+d) = \frac{62.5 \times 62.5}{2}(73.5) = 143000^{\#}/\text{lin. ft.}$$ (Acc. M-253)



$H = \frac{3}{5}P = 85800^{\#}$ per lin. ft.

$V = \frac{4}{5}P = 114300^{\#}$ " " "

Point of application of resultant (P)

Let x = dist. along deck from heel.

From Acc. M-253, $R_A x = R_B(l-x) = R_B l - R_B x$

$\therefore x(R_A + R_B) = R_B l$ or $x = \frac{R_B l}{R_A + R_B}$

$$x = \frac{\frac{\gamma l}{6}(h+2d)l}{\frac{\gamma l}{6}(d+2h+2d+h)} = \frac{(h+2d)l}{3(d+h)} = \frac{(55.5 + 2 \times 18)62.5}{3(55.5+18)} = 25.9$$

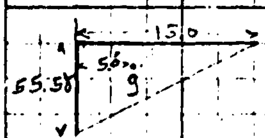
Overturning Moment: 19 ft. section.

Hor. comp. of water:-

$85800 \times 19 \times 15.5 = 25300000$ ft.-lbs.

Uplift at heel: γh at heel, 0.0 at toe; effective over whole surface

Upward pressure $= \frac{55.5 \times 62.5}{2} \times 15 \times 19 = 495000$



Lever arm = 60 ft.; moment about toe = 60×495000

$= 29700000$

Total Overturning Moment 55000000 ft.-lbs.

STATE OF NEW YORK CONSERVATION COMMISSION

SUBJECT Fillmore Falls Dam — International Paper Co. FILE NO.

Pier #7 - Stability against Sliding ACC. NO. C-342

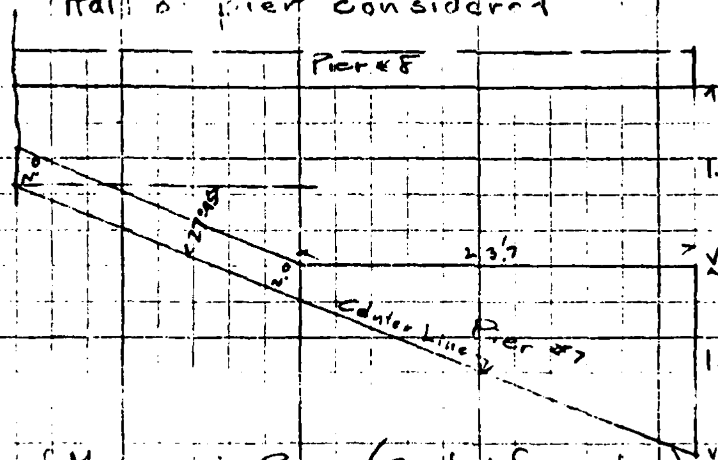
SHEET 2

COMPUTER E.T.C. July 31, 1931 CHECKED BY ... 19...

MADE IN CONNECTION WITH

CONT'D FROM ACC.

Half of pier considered



$H_w = 348000$ #

Slope of deck = 3 on 4

$\therefore \frac{H_w}{V_w} = \frac{3}{4}$

$V_w = \frac{4}{3} H_w$

$= \frac{4}{3} \times 348000 = 464000$ #

Wt. of Masonry in Pier (Scaled from plan)

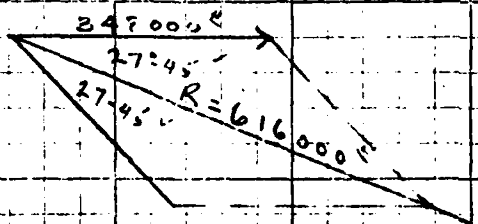
9.0 × 24.5 × 20.0	= 4410 cu. ft.
2 × 20.0 × 10	400
9.0 × 25.0 × $\frac{8}{3}$	750
2.5 × 20.0 × 7.5	375
2.5 × 9.0 × 12.5	281
2.5 × 12.0 × 18.0	540
11.0 × 36.5	390
	7146 cu. ft. (½ pier)

7146 × ~~150~~ 145 = 1,036,000 #

464,000

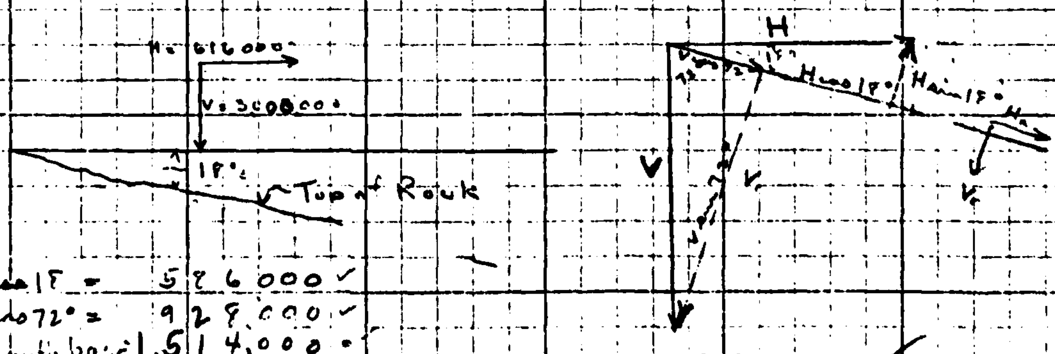
V (½ pier) = 1,500,000 #

Resultant H in direction of ℄ of pier



$H_R = 2 \times 348000 \times \cos 27°45' = 616000$ #

V = 3,000,000 #



616000 × cos 18° = 586000

3,000,000 × cos 72° = 928000

Force parallel with base = 1,514,000

616,000 × sin 18° = − 190,000

3,000,000 × sin 72° = 2850000

Force normal to base = 2660000

Coef. of Friction = $\frac{1514}{2660}$ = 0.57 - Too High

Allowable Coef. of Fric. = 0.35 (Factor of safety of 2

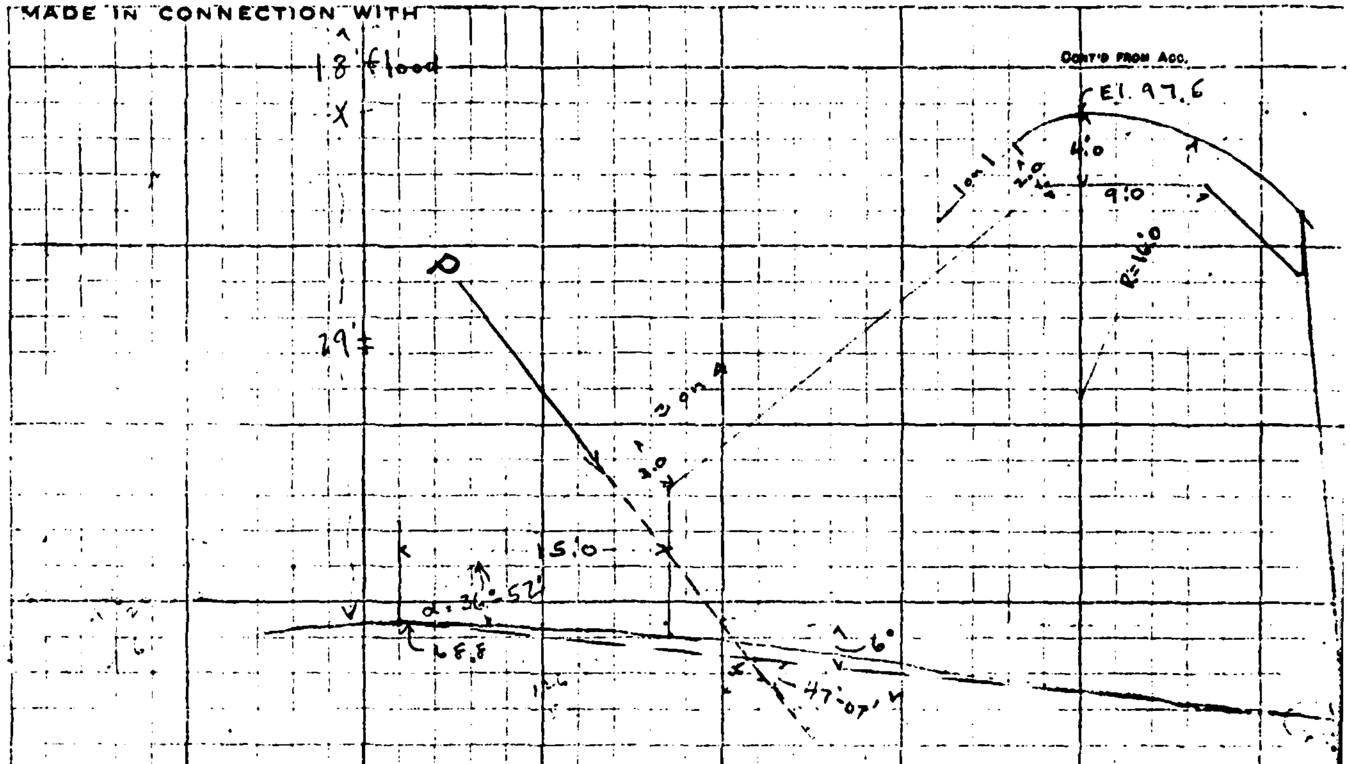
SUBJECT Palmer Falls Dam - International Paper Co — FILE NO. H

Computation of Stresses — ACC. NO. C-341

SHEET 1

COMPUTER — 19 — CHECKED BY — 19

MADE IN CONNECTION WITH



Section - Pier # 8

Maximum Discharge :- say 100,000 sec ft.

Length of spillway :- 370 ft. (Scaled from plan.

$\frac{100,000}{370}$ = 270 sec ft. per foot of crest.

$Q = 3.33\, L H^{3/2}$, $L = 1$, $Q = 270$.

$H = \left(\frac{270}{3.33}\right)^{2/3} = (81)^{2/3}$ Log 81 = 1.908485

3) 3.816970

1.272323 = 18.7 = H.

Assume H = 18 ft.

$P = \frac{\gamma d}{2}(h+d) = \frac{62.5 \times 47}{2}(47+18) = 97500$ # per lin ft (Acc. ...

H = P sin α = 97500 × 0.600 = 58500 × 15 = 877,000 #

V = P cos α = 97500 × 0.800 = 78000 × 15 = 1,155,000 #

Along surface = P cos 47° 07' = 0.680 × 97500 × 15 = 995,000 #

Wt. of Masonry

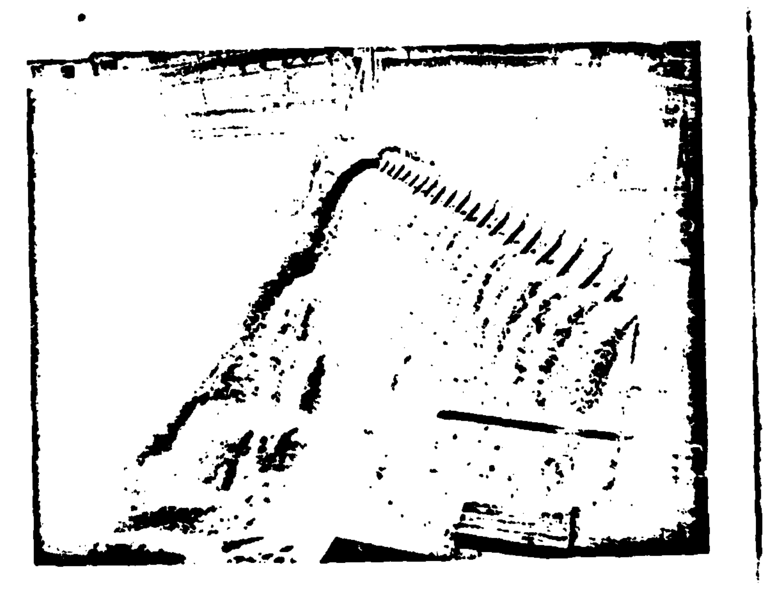
$\left\{\left(15 \times \frac{12}{2} + \left(\frac{4+2}{2}\right) \times 27 + 3 \times 10 + 2 \times 6\right) \times 15 + \left[\frac{9+29}{2} \times 21 + \frac{30+2}{2} \times 15\right] \times 4\right\} 150 = 956,000$ #

Total V = 1155,000 + 956000 = 2,111,500 #, × 33 = 703,800

Shear - (50 # sq in) Pier, 37 × 4 × 144 × 50 = 1,060,000 # O.K.

#261 U-H.
8-26-71

C135041



2	46		000361	082671	034	4
RB	CTY	YR AP.	DAM NO.	INS. DATE	USE	TYPE

AS BUILT INSPECTION

1	Location of Sp'way and outlet	1	Elevations
1	Size of Sp'way and Outlet	1	Geometry of Non-overflow section

1 GENERAL CONDITION OF NON-OVERFLOW SECTION

1	Settlement	2	Cracks	1	Deflections
2	Joints	2	Surface of Concrete	1	Leakage
1	Undermining	1	Settlement of Embankment	1	Crest of Dam
1	Downstream Slope	1	Upstream Slope	1	Toe of Slope

1 GENERAL COND. OF SP'WAY AND OUTLET WORKS

2	Auxiliary Spillway	2	Service or Concrete Sp'way	1	Stilling Basin
2	Joints	2	Surface of Concrete	1	Spillway Toe
2	Mechanical Equipment	1	Plunge Pool	1	Drain

1	Maintenance	2	Hazard Class
3	Evaluation	34	Inspector

COMMENTS:

GATES #19 & 20 LEAKING SLIGHTLY

1. River Basin - Nos. 1-23 on Compilation Sheets
2. County - Nos. 1-62 Alphabetically
3. Year Approved -
4. Inspection Date - Month, Day, Year
5. Apparent use -
   1. Fish & Wildlife Management
   2. Recreation
   3. Water Supply
   4. Power
   5. Farm
   6. No Apparent Use
6. Type -
   1. Earth with Aux. Service Spillway
   2. Earth with Single Conc. Spillway
   3. Earth with Single non-conc. Spillway
   4. Concrete
   5. Other
7. As-Built Inspection - Built substantially according to approved plans and specifications

Location of Spillway and Outlet Works

1. Appears to meet originally approved plans and specifications.
2. Not built according to plans and specifications and location appears to be detrimental to structure.
3. Not built according to plans and specifications but location does not appear to be detrimental to structure.

Elevations

1. Generally in accordance to approved plans and specifications as determined from visual inspection and use of hand level.
2. Not built according to plans and specifications and elevation changes appear to be detrimental to structure.
3. Not built according to plans and specifications but elevation changes do not appear to be detrimental to structure.

Size of Spillway and Outlet Works

1. Appears to meet originally approved plans and specifications as determined by field measurements using tape measure.
2. Not built according to plans and specifications and changes appear detrimental to structure.
3. Not built according to plans and specifications but changes do not appear detrimental to structure.

Geometry of Non-overflow Structures

1. Generally in accordance to originally approved plans and specifications as determined from visual inspection and use of hand level and tape measure.
2. Not built according to plans and specifications and changes appear detrimental to structure.
3. Not built according to plans and specifications but changes do not appear detrimental to structure.

General Conditions of Non-Overflow Section

1. Adequate - No apparent repairs needed or minor repairs which can be covered by periodic maintenance.
2. Inadequate - Items in need of major repair.

ITEMS For boxes listed on condition under non-overflow section.
1. Satisfactory.
2. Can be covered by periodic maintenance.
3. Unsatisfactory - Above and beyond normal maintenance.

General Condition of Spillway and Outlet Works

1. Adequate - No apparent repairs needed or minor repairs which can be covered by periodic maintenance.
2. Inadequate - Items in need of major repair.

Items) For boxes listed conditions listed under spillway and outlet works.
1. Satisfactory.
2. Can be covered by periodic maintenance.
3. Unsatisfactory - Above and beyond normal maintenance.
4. Dam does not contain this feature.

Maintenance

1. Evidence of periodic maintenance being performed.
2. No evidence of periodic maintenance.
3. No longer a dam or dam no longer in use.

(S.C.S.) Hazard Classification Downstream

CLASSIFICAT[ION] CORPS ENG[INEERS]

1. (A) Damage to agriculture and county roads. (III)
2. (B) Damage to private and/or public property. (II)
3. (C) Loss of life and/or property. (I)

Evaluation - Based on Judgment and Classification in Box Nos.

Evaluation for Unsafe Dam

1. Unsafe - Repairable.
2. Unsafe - Not Repairable.
3. Insufficient evidence to declare unsafe.

RIVER BASINS

(1) LOWER HUDSON
(2) UPPER HUDSON
(3) MOHAWK
(4). LAKE CHAMPLAIN
(5) DELAWARE
(6) SUSQUEHANNA
(7) CHEMUNG
(8) OSWEGO
(9) GENESEE
(10) ALLEGHENY
(11) LAKE ERIE
(12) WESTERN LAKE ONTARIO
(13) CENTRAL LAKE ONTARIO
(14) EASTERN LAKE ONTARIO
(15) SALMON RIVER
(16) BLACK RIVER
(17) WEST ST. LAWRENCE
(18) EAST ST. LAWRENCE
(19) RACQUETTE RIVER
(20) ST. REGIS RIVER
(21) HOUSATONIC
(22) LONG ISLAND
(23) OSWEGATCHIE
(24) GRASSE

COUNTIES

STATE NAME: NEW YORK

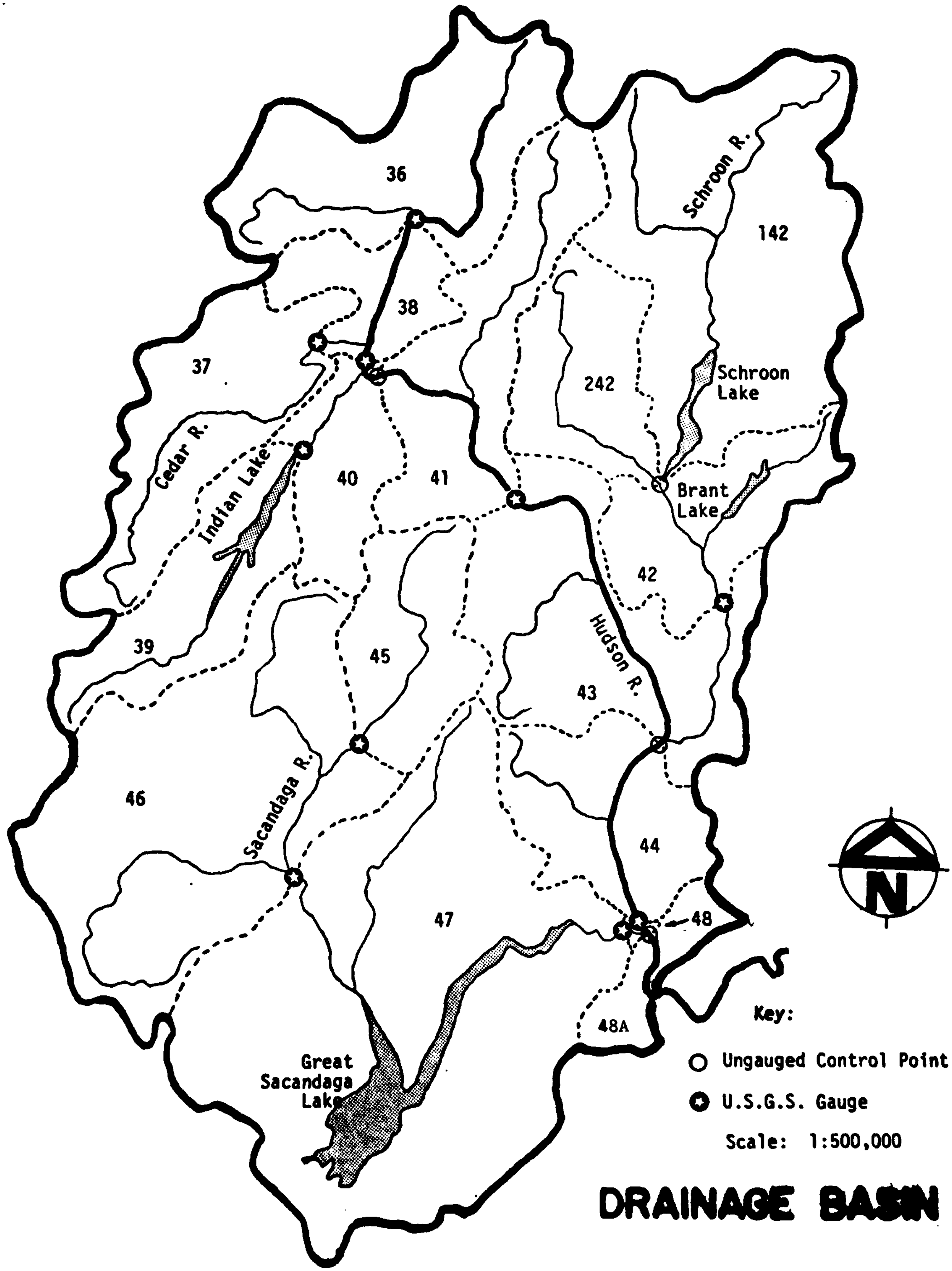
STATE ABBREVIATION: NY

STATE CODE: 36

CODE	COUNTY NAME
1	ALBANY
2	ALLEGANY
3	BRONX
4	BROOME
5	CATTARAUGUS
6	CAYUGA
7	CHAUTAUQUA
8	CHEMUNG
9	CHENANGO
10	CLINTON
11	COLUMBIA
12	CORTLAND
13	DELAWARE
14	DUTCHESS
15	ERIE
16	ESSEX
17	FRANKLIN
18	FULTON
19	GENESEE
20	GREENE
21	HAMILTON
22	HERKIMER
23	JEFFERSON
24	KINGS
25	LEWIS
26	LIVINGSTON
27	MADISON
28	MONROE
29	MONTGOMERY
30	NASSAU
31	NEW YORK
32	NIAGARA
33	ONEIDA
34	ONONDAGA
35	ONTARIO
36	ORANGE
37	ORLEANS
38	OSWEGO
39	OTSEGO
40	PUTNAM
41	QUEENS
42	RENSSELAER
43	RICHMOND
44	ROCKLAND
45	ST LAWRENCE
46	SARATOGA
47	SCHENECTADY
48	SCHOHARIE
49	SCHUYLER
50	SENECA
51	STEUBEN
52	SUFFOLK
53	SULLIVAN
54	TIOGA
55	TOMPKINS
56	ULSTER
57	WARREN
58	WASHINGTON
59	WAYNE
60	WESTCHESTER
61	WYOMING
62	YATES

APPENDIX C

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



DRAINAGE BASIN

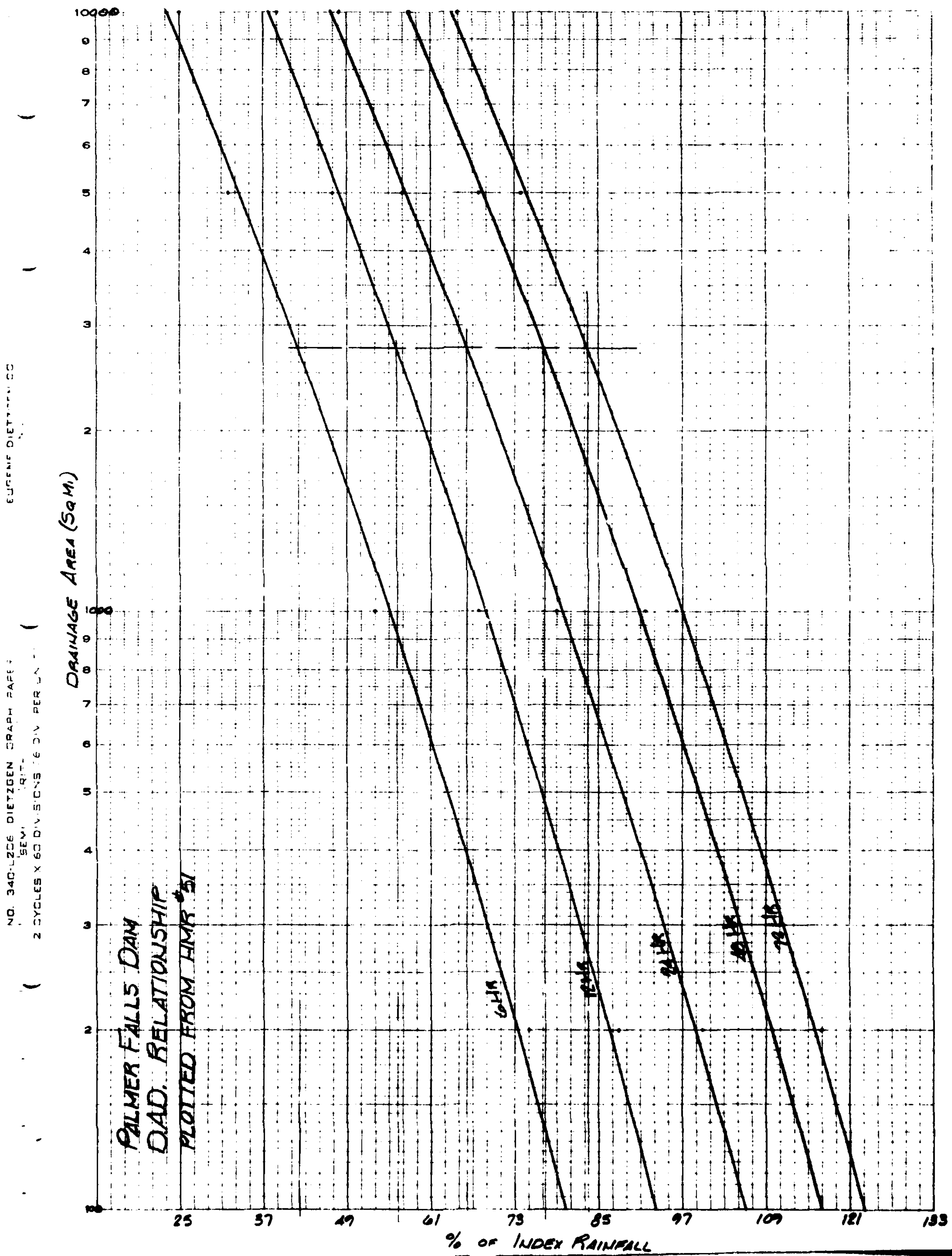
From HMR #51

Area	Duration	Depth	% Index
200 mi^2	6 hr	15.5"	75
	12	18.2	88
	24	20.6	100 ← PMF INDEX RAINFALL
	48	22.7	110
	72	24.2	117
1000 mi^2	6	10.9	53
	12	14.0	68
	24	16.2	79
	48	19.0	92
	72	19.8	96
5000 mi^2	6	6.6	32
	12	9.7	47
	24	11.8	57
	48	14.0	68
	72	15.3	74
10,000 mi^2	6	5.1	25
	12	8.0	39
	24	9.9	48
	48	12.0	58
	72	13.3	65

DRAINAGE AREA 2750 SQ MI

PMF RATIO

DURATION	% INDEX	DEPTH
6 HR	42	8.7
12 HR	56	11.5
24 HR	66	13.6
48 HR	77	15.9
72 HR	84	17.2



PALMER FALLS DAM
DAD. RELATIONSHIP
PLOTTED FROM HMR #51
DRAINAGE AREA (SQ MI.)
% OF INDEX RAINFALL
6 HR
12 HR
24 HR
48 HR
72 HR
10000
1000
100
25
37
49
61
73
85
97
109
121
133
NO. 340-L206 DIETZGEN GRAPH PAPER
SEMI-LOG
2 CYCLES X 60 DIVISIONS PER INCH
EUGENE DIETZGEN CO.

STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501 TEL 315-797-5800 **DESIGN BRIEF**

ROJECT NAME 1980 N.Y.S. Dam Inspections DATE

SUBJECT Palmer Falls PROJECT NO.

DRAWN BY

Sub-Area 48A

Hydrograph Parameters based on "Upper Hudson & Mohawk River Basins Hydrologic Flood Routing Models - Corps of Engineers

$(T_c + R) = 7.52 A^{0.215} * St^{0.425}$ Eqn. 5.3a

$R = 3.30 A^{0.155} * St^{0.775}$ Eqn. 5.3b

Good for $15 \le A \le 1000$ mi²
$1.05 \le St \le 4.10$

A = drainage area, mi²
St = Surface area of lakes and reservoirs as percent of total drainage area, % + 1.0

T_c, R = Clark unit hydrograph parameters, hrs.

A = 35.2 mi²
St = 1.45

$R = 3.3 (35.2)^{0.155} * (1.45)^{0.775} = 7.64$

$(T_c + R) = 7.52 (35.2)^{0.215} * (1.45)^{0.425} = 18.94$

$T_c = 11.3$

Initial Flow, STRTQ = 45 cfs for A = 35 mi² Fig. 5.1

Recession Flow, QRCSN = 350 cfs for A = 35 Fig. 5.3

... 3

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TEL 315-797-5800

ROJECT NAME ______ DATE ______

SUBJECT Palmer Falls PROJECT NO. ______

Spillway Stage-Discharge Curve DRAWN BY ______

$Q = CLH^{3/2}$

C from King & Brater - "Handbook of Hydraulics" for a similar section

Total Length of 2 sections = 205 + 141' = 346'

Elev.	H	C	Q (cfs)
517.17	0	—	0
518	0.83	3.1	811
519	1.83	3.2	2740
520	2.83	3.25	5354
521	3.83	3.3	8560
522	4.83	3.3	12120
523	5.83	3.3	16070
524	6.83	3.3	20380
525	7.83	3.3	25015
526	8.83	3.3	29960
528	10.83	3.35	41310
530	12.83	3.4	54060
532	14.83	3.45	68170
534	16.83	3.5	83610
536	18.83	3.55	100,360
538	20.83	3.6	118,420
543	25.83	3.65	165,800
548	30.83	3.65	216,200
553	35.83	3.65	270,850
558	40.83	3.65	329,500

STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501 TEL 315-797-5800 **DESIGN BRIEF**

PROJECT NAME New York State Dam Inspection DATE 5·12·80

SUBJECT Palmer Falls Dam PROJECT NO. 2399

Stage Storage DRAWN BY JPG

Impoundment Approx 350' width x 2750' length

Chan Slope = 2%, Side Slopes = 1:1.5

	Stage	Area	Vol	Σ Vol
	480.0	0		
	482.0	303x100	.696	.696
	484.0	306x200	2.101	2.796
	486.0	309x300	3.533	6.329
	488.0	312x400	4.993	11.322
	490.0	315x500	6.481	17.803
	492.0	318x600	7.996	25.799
	494.0	321x700	9.539	35.338
	496.0	324x800	11.109	46.447
	498.0	327x900	12.707	59.154
	500.0	330x1000	14.332	73.486
	502.0	333x1100	15.985	89.471
	504.0	336x1200	17.665	107.136
	506.0	339x1300	19.373	126.509
	508.0	342x1400	21.109	147.618
	510.0	345x1500	22.872	170.490
	512.0	348x1600	24.663	195.153
	514.0	351x1700	26.500	221.653
	516.0	354x1800	28.326	249.979
Crest	517.0	355.5x1850	29.263	279.242
	518.0	357x1900	30.200	309.442
	520.0	360x2000	32.101	341.543
	522.0	363x2100	34.029	375.572
	524.0	366x2200	35.985	411.557
	526.0	369x2300	37.968	449.525
	528.0	372x2400	39.979	489.504
	530.0	375x2500	42.018	521.522
	540.	390x2750	230.7	752.2
	560.	420x2750	511.4	1263.6

STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501 TEL 315-797-5800 **DESIGN BRIEF**

ROJECT NAME N.Y.S. Dam Inspections - 1980 DATE

SUBJECT Palmer Falls PROJECT NO.

Discharge Rating - Upper Forebay Outlets DRAWN BY

Assumptions: No flow through plant and sufficient number of gates open into upper forebay to fully utilize outflow capacity of 2 outflow gates

2 gates, openings 12'x12'
invert @ elev. 506.67
Top of Spillway @ 517.17
Top of Flashboards @ ~ 521

Flows from Fig. B-12 "Design of Small Dams"

Elev.	H	Q	
517.17	10.5'	1045 cfs	; 2090 for 2 openings
521	14.33'	1630 cfs	; 3260 for 2

```
A1              PALMER FALLS DAM                                                            PAGE 0001

(0001)    A1                PALMER FALLS DAM
(0002)    A2                PMF OVERTOPPING ANALYSIS
(0003)    A3                MODEL DERIVED FROM UPPER HUDSON C OF E MODEL
(0004)    B     150        1        0        0        0        0        0        0        4
(0005)    B1      ?
(0006)    J       1        7        1
(0007)    J1    0.2      0.3      0.4      0.5      0.6      0.8      1.0
(0008)    K       0       36
(0009)    M       1        0      192        0     2740        0
(0010)    P       0     20.6       42       56       66       77       84
(0011)    T       0        0        0        0        0        0      1.0    0.075
(0012)    V   20.13    22.01
(0013)    X     340     2550      1.3
(0014)    K       1     3638
(0015)    Y       0
(0016)    Y1      3        0        0     1.31       .3
(0017)    K       ?       38
(0018)    M       1        0       67        0     2740        0
(0019)    F       0     20.6       42       56       66       77       84
(0020)    T       0        0        0        0        0        0      1.0    0.075
(0021)    V   14.82    15.53
(0022)    X      95      700      1.3
(0023)    K       0       37
(0024)    M       1        0      160        0     2740        0
(0025)    F       0     20.6       42       56       66       77       84
(0026)    T       0        0        0        0        0        0      1.0    0.075
(0027)    V   19.11    21.23
(0028)    X     270     2100      1.3
(0029)    K       1     3758
(0030)    Y       0
(0031)    Y1      1        0        0     1.00       .3
(0032)    K       3       38
(0033)    K       0       39
(0034)    M       1        0      132        0     2740        0
(0035)    F       0     20.6       42       56       66       77       84
(0036)    T       0        0        0        0        0        0      1.0    0.075        0      .05
(0037)    V   16.09    10.13
(0038)    X     240     1750      1.3
```

```
(0039)  K       1      39       0       0       0       0       1
(0040)  K1       ROUTE THRU INDIAN LAKE
(0041)  Y       0       0       0       1
(0042)  Y1      1       0       0       0       0       0  106560.
(0043)  Y2     0.  36210.  92680. 106560. 114350. 118250. 123060. 128100. 134100. 138460.
(0044)  Y3     0.      0.      0.      0.    700.   1440.   2340.   3370.   4525.   5785.
(0045)  K       1    3940
(0046)  Y       0
(0047)  Y1      1       0       0    1.00      .3
(0048)  K       0      40
(0049)  M       1       0      72       0    2740       0
(0050)  P       0    20.6      42      56      66      77      84
(0051)  T       0       0       0       0       0       0     1.0   0.075
(0052)  V   15.27   17.66
(0053)  X     110     800     1.3
(0054)  K       3      40
(0055)  K       1    4041       0       0       0       0       1
(0056)  K1       ROUTE TO 1041
(0057)  Y       0
(0058)  Y1      2       0       0    2.12      .2
(0059)  K       0      41
(0060)  M       1       0     169       0    2740       0
(0061)  P       0    20.6      42      56      66      77      84
(0062)  T       0       0       0       0       0       0     1.0   0.075
(0063)  V   18.04   13.00
(0064)  X     290    2300     1.3
(0065)  K       2      41
(0066)  K       1    4143       0       0       0       0       1
(0067)  K1       ROUTE TO CONFLUENCE WITH SCHROON RIVER
(0068)  Y       0
(0069)  Y1      3       0       0    2.08      .2
(0070)  K       0     142
(0071)  M       1       0     313       0    2740       0
(0072)  P       0    20.6      42      56      66      77      84
(0073)  T       0       0       0       0       0       0     2.0   0.075
(0074)  V   22.15   17.72
(0075)  X     600    4300     1.3
(0076)  K       1     142       0       0       0       0       1
```

(0077)	K1	ROUTE THRU SCHROON LAKE							
(0078)	Y	0							
(0079)	Y1	1	0	0	55.				
(0080)	K	0	242						
(0081)	M	1	0	69	0	2740	0	84	
(0082)	P	0	20.6	42	56	66	77	2.0	0.075
(0083)	T	0	0	0	0	0	0		
(0084)	V	15.56	11.43						
(0085)	X	152	1100	1.3					
(0086)	K	2	142						
(0087)	K	1	14242						
(0088)	Y	0							
(0089)	Y1	3	0	0	1.51	.1			
(0090)	K	0	42						
(0091)	M	1	0	115	0	2740	0	84	
(0092)	P	0	20.6	42	56	66	77	2.0	0.075
(0093)	T	0	0	0	0	0	0		
(0094)	V	15.13	8.99						
(0095)	X	163	1350	1.3					
(0096)	K	1	42						
(0097)	Y	0							
(0098)	Y1	1	0	0	45.				
(0099)	K	2	42						
(0100)	K	1	4243						
(0101)	Y	0							
(0102)	Y1	5	0	0	1.63	.3			
(0103)	K	3	43						
(0104)	M	1	0	227	0	2740	0	84	
(0105)	P	0	20.6	42	56	66	77	1.0	0.075
(0106)	T	0	0	0	0	0	0		
(0107)	V	18.54	11.07						
(0108)	X	4[illegible]0	3100	1.3					
(0109)	K	3	43						
(0110)	K	1	4344	0	0	0	0	1	
(0111)	K1	ROUTE TO 1[illegible]44							
(0112)	Y	0							
(0113)	Y1	6	0	0	1.59	.2			
(0114)	K	0	44						

```
(0115)  M       1       0     118       0    2740       0
(0116)  F       0    20.6      42      56      66      77      84
(0117)  T       0       0       0       0       0       0     1.0   0.075
(0118)  V   15.83    9.66
(0119)  X     165    1500     1.3
(0120)  K       2      44       0       0       0       0       1
(0121)  K1        COMBINE 2 HYDROGRAPHS AT HADLEY, NY
(0122)  K       0      45
(0123)  M       1       0     114       0    2740       0
(0124)  F       0    20.6      42      56      66      77      84
(0125)  T       0       0       0       0       0       0     1.0   0.075
(0126)  V   16.11   11.77
(0127)  X     165    1350     1.3
(0128)  K       1    4546       0       0       0       0       1
(0129)  K1        ROUTE TO 1146
(0130)  Y       0
(0131)  Y1      2       0       0    1.29      .3
(0132)  K       0      46
(0133)  M       1       0     377       0    2740       0
(0134)  F       0    20.6      42      56      66      77      84
(0135)  T       0       0       0       0       0       0     1.0   0.075
(0136)  V   24.41   26.10
(0137)  X     745    5300     1.3
(0138)  K       2      46
(0139)  K       1    4647       0       0       0       0       1
(0140)  K1        ROUTE TO 1147
(0141)  Y       0
(0142)  Y1      2       0       0    1.47      .3
(0143)  K       0      47
(0144)  M       1       0     564       0    2740       0
(0145)  F       0    20.6      42      56      66      77      84
(0146)  T       0       0       0       0       0       0     1.0   0.075
(0147)  V   24.16   14.73
(0148)  X     125    7600     1.3
(0149)  K       2      47
(0150)  K       1      47       0       0       0       0       1
(0151)  K1        ROUTE TO 1047 THRU GREAT SACANDAGA LAKE
(0152)  Y               0       0       1
```

A1   PALMER FALLS DAM   PAGE 0005

```
(0153)   Y1       1        0        0        0        0        0  765302.
(0154)   Y2435941   655418   707300   753700   765611   814279   841598   941250  1003213  1065197
(0155)   Y3  7275     7648     7970     8029     8220    11971    23187    41164    52464    65095
(0156)   K        0       48
(0157)   M        1        0        0        0     2740        0
(0158)   P        0     20.6       42       56       66       77       84
(0159)   T        0        0        0        0        0        0      1.0    0.075
(0160)   V     5.61     3.92
(0161)   X        5        5      1.3
(0162)   K        3       46        0        0        0        0        1
(0163)   K1        COMBINE 3 HYDROGRAPHS AT 1048 - HUDSON R. BELOW SACANDAGA R.
(0164)   K        1    48257        0        0        0        0        1
(0165)   K1        ROUTE TO PALMER FALLS DAM
(0166)   Y        0
(0167)   Y1       5        0        0     2.27       .2
(0168)   K        0    257.5        0        0        0        0        1
(0169)   K1       RUNOFF SUB-AREA 48A
(0170)   M        1        0     35.2        0     2740        0
(0171)   P        0     20.6       42       56       66       77       84
(0172)   T        0        0        0        0        0        0      1.0    0.075
(0173)   V     11.3     7.64
(0174)   X       45      350      1.3
(0175)   K        2    257.5        0        0        0        0        1
(0176)   K1        COMBINE 2 HYDROGRAPHS AT PALMER FALLS DAM
(0177)   K        1   1257.5        0        0        0        0        1
(0178)   K1       ROUTE OVER PALMER FALLS DAM
(0179)   Y        0        0        0        1
(0180)   Y1       1        0        0        0        0        0  -517.17       -1
(0181)   Y4517.17      518      519      520      521      522      523      524      525      526
(0182)   Y4   528      530      532      534      536      538      543      548      553      558
(0183)   Y5     0      811     2740     5355     8560    12120    16070    20360    25015    29960
(0184)   Y5 41310    54660    68170    83610   100360   118420   165800   216200   270850   329500
(0185)   $$     0      2.8     11.3     25.8     46.4     73.5    107.1    147.6    195.1      250
(0186)   $$ 279.2    309.4    375.6    449.5    521.5      752     1264
(0187)   SE   480      484      486      492      496      500      504      508      512      516
(0188)   SE   517      518      522      526      530      540      560
(0189)   $$517.17
(0190)   $D 531.7     2.64      1.5       80
```

```
PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS
          RUNOFF HYDROGRAPH AT              36
          ROUTE HYDROGRAPH TO             3638
          RUNOFF HYDROGRAPH AT              38
          RUNOFF HYDROGRAPH AT              37
          ROUTE HYDROGRAPH TO             3738
          COMBINE  3 HYDROGRAPHS AT         38
          RUNOFF HYDROGRAPH AT              39
          ROUTE HYDROGRAPH TO               39
          ROUTE HYDROGRAPH TO             3940
          RUNOFF HYDROGRAPH AT              40
          COMBINE  3 HYDROGRAPHS AT         40
          ROUTE HYDROGRAPH TO             4041
          RUNOFF HYDROGRAPH AT              41
          COMBINE  2 HYDROGRAPHS AT         41
          ROUTE HYDROGRAPH TO             4143
          RUNOFF HYDROGRAPH AT             142
          ROUTE HYDROGRAPH TO              142
          RUNOFF HYDROGRAPH AT             242
          COMBINE  2 HYDROGRAPHS AT        142
          ROUTE HYDROGRAPH TO            14242
          RUNOFF HYDROGRAPH AT              42
          ROUTE HYDROGRAPH TO               42
          COMBINE  2 HYDROGRAPHS AT         42
          ROUTE HYDROGRAPH TO             4243
          RUNOFF HYDROGRAPH AT              43
          COMBINE  3 HYDROGRAPHS AT         43
          ROUTE HYDROGRAPH TO             4344
          RUNOFF HYDROGRAPH AT              44
          COMBINE  2 HYDROGRAPHS AT         44
          RUNOFF HYDROGRAPH AT              45
          ROUTE HYDROGRAPH TO             4546
          RUNOFF HYDROGRAPH AT              46
          COMBINE  2 HYDROGRAPHS AT         46
          ROUTE HYDROGRAPH TO             4647
          RUNOFF HYDROGRAPH AT              47
          COMBINE  2 HYDROGRAPHS AT         47
          ROUTE HYDROGRAPH TO               47
          RUNOFF HYDROGRAPH AT              48
          COMBINE  3 HYDROGRAPHS AT         48
          ROUTE HYDROGRAPH TO            48257
          RUNOFF HYDROGRAPH AT           257.5
          COMBINE  2 HYDROGRAPHS AT      257.5
          ROUTE HYDROGRAPH TO           1257.5
          END OF NETWORK
```

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATE?TUE, MAY 27 1980
     TIME?15:43:40

                                PALMER FALLS DAM
                                PMF OVERTOPPING ANALYSIS
                                MODEL DERIVED FROM UPPER HUDSON C OF E MODEL

                                          JOB SPECIFICATION
                   NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
                  150        1        0        0        0        0        0        0        4        0
                                           JOPER      NWT    LROPT    TRACE
                                               5        0        0        0

                                    MULTI-PLAN ANALYSES TO BE PERFORMED
                                        NPLAN= 1 NRTIO= 7 LRTIO= 1
                    RTIOS=    0.20    0.30    0.40    0.50    0.60    0.80    1.00

          **********          **********          **********          **********          **********

                                       SUB-AREA RUNOFF COMPUTATION
                              ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                                 36       0       0       0       0       0       0       0       0

                                            HYDROGRAPH DATA
                   IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                       1       0  192.00    0.00 2740.00    0.00   0.000       0       0       0

                                              PRECIP DATA
                            SPFE     PMS      R6     R12     R24     R48     R72     R96
                            0.00   20.60   42.00   56.00   66.00   77.00   84.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                                                LOSS DATA
               LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
                   0    0.00    0.00    1.00    0.00    0.00    1.00    1.00    0.07    0.00    0.00

                                           UNIT HYDROGRAPH DATA
                                   TC= 20.13      R= 22.01      NTA=  0

                                              RECESSION DATA
                                STRTQ=  340.00    QRCSN= 2550.00    RTIOR= 1.30

                 UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG=  18.94 HOURS, CP= 0.55  VOL= 0.98
```

```
     43.      163.      336.      544.      778.     1032.     1302.     1586.     1881.     2185.
   2487.     2767.     3012.     3223.     3399.     3541.     3645.     3711.     3733.     3699.
   3506.     3429.     3277.     3131.     2992.     2859.     2732.     2611.     2495.     2384.
   2272.     2177.     2080.     1988.     1899.     1815.     1734.     1657.     1584.     1513.
   1446.     1382.     1320.     1262.     1206.     1152.     1101.     1052.     1005.      961.
    918.      877.      836.      801.      765.      731.      699.      668.      638.      610.
    583.      557.      532.      509.      486.      464.      444.      424.      405.      387.
    370.      354.      338.      323.      308.      295.      282.      269.      257.      246.
    235.      224.      214.      205.      196.      187.      179.      171.      163.      156.
    149.      142.      136.      130.      124.      119.      114.      108.      104.       99.

        0                                   END-OF-PERIOD FLOW
MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q       MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                        SUM   16.02  11.85   4.18  147442.
                                                                            ( 407.)( 301.)( 106.)(4175.88)


        **********          **********          **********          **********          **********

                                          HYDROGRAPH ROUTING
                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                          3638       1       0       0       0       0       0       0       0
                                            ROUTING DATA
                 QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                   0.0   0.000    0.00       0       0       0       0               0

                         NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                             3       0       0   1.310   0.300   0.000     0.        0


        **********          **********          **********          **********          **********

                                    SUB-AREA RUNOFF COMPUTATION
                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                            38       0       0       0       0       0       0       0       0

                                            HYDROGRAPH DATA
             IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                 1       0   67.00    0.00 2740.00    0.00   0.000       0       0       0

                                              PRECIP DATA
                      SPFE     PMS      R6     R12     R24     R48     R72     R96
                      0.00   20.60   42.00   56.00   66.00   77.00   84.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                                               LOSS DATA
          LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
              0    0.00    0.00    1.00    0.00    0.00    1.00    1.00    0.07    0.00    0.00

                                          UNIT HYDROGRAPH DATA
```

```
              TC= 14.22     R= 15.55     NTA=  0

                          RECESSION DATA
               STRTG=    55.00    QRCSN=   700.00    RTIOR= 1.33

  UNIT HYDROGRAPH 91 END-OF-PERIOD ORDINATES, LAG=  13.72 HOURS, CP= 0.56  VOL= 1.00
    33.     126.     256.     415.     569.     776.     973.    1174.    1361.    1517.
  1642.    1735.    1794.    1816.    1785.    1698.    1592.    1493.    1400.    1312.
  1231.    1154.    1082.    1014.     951.     892.     836.     784.     735.     689.
   646.     606.     568.     533.     499.     468.     439.     412.     386.     362.
   339.     318.     298.     280.     262.     246.     231.     216.     203.     190.
   178.     167.     157.     147.     138.     129.     121.     114.     106.     100.
    94.      88.      82.      77.      72.      68.      64.      60.      56.      52.
    49.      46.      43.      40.      38.      36.      33.      31.      29.      28.
    26.      24.      23.      21.      20.      19.      18.      16.      15.      14.
    14.

    0                                 END-OF-PERIOD FLOW
 MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q     MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                    SUM  16.02  11.65   4.18   522539.
                                                                       ( 407.)( 301.)( 106.)(14796.64)


 **********       **********       **********       **********       **********

                            SUB-AREA RUNOFF COMPUTATION
                    ISTAQ   ICOMP   IECON   ITAPE   JPLT    JPRT   INAME  ISTAGE   IAUTO
                       37       0       0       0      0       0       0       0       0

                                  HYDROGRAPH DATA
           IHYDG    IUHG   TAREA     SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
               1       0  160.00     0.00 2740.00    0.00   0.000       0       0       0

                                   PRECIP DATA
                     SPFE      PMS      R6      R12     R24     R48     R72     R96
                     0.00    20.60   42.00    56.00   66.00   77.00   84.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                                    LOSS DATA
        LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
            0    0.00    0.00    1.00    0.00    0.00    1.00    1.00    0.07    0.00    0.00

                                 UNIT HYDROGRAPH DATA
                         TC= 19.11     R= 21.23     NTA=  0

                                  RECESSION DATA
               STRTG=   270.00    QRCSN= 2100.00    RTIOR= 1.30

  UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG=  18.04 HOURS, CP= 0.55  VOL= 0.99
    40.     152.     314.     507.     724.     960.    1211.    1474.    1747.    2026.
  2294.    2532.    2736.    2908.    3047.    3150.    3217.    3242.    3215.    3114.
```

```
  2972.     2835.     2705.     2580.     2462.     2346.     2240.     2137.     2039.     1945.
  1856.     1770.     1689.     1611.     1537.     1466.     1399.     1334.     1273.     1214.
  1156.     1105.     1054.     1006.      959.      915.      873.      833.      795.      758.
   723.      690.      658.      628.      599.      571.      545.      520.      496.      473.
   452.      431.      411.      392.      374.      357.      340.      325.      310.      295.
   282.      269.      257.      245.      233.      223.      212.      203.      193.      184.
   176.      168.      160.      153.      146.      139.      133.      127.      121.      115.
   110.      105.      100.       95.       91.       87.       83.       79.       75.       72.

    0                                        END-OF-PERIOD FLOW
MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q      MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q
                                                                            SUM  16.02  11.85   4.18  1231913.
                                                                               ( 407.)( 301.)( 106.)(34883.86)


      **********        **********        **********        **********        **********

                                 HYDROGRAPH ROUTING
                   ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                    3738       1       0       0       0       0       0       0       0
                                       ROUTING DATA
          QLOSS    CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
            0.0    0.000    0.00       0       0       0       0               0

                   NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                       1       0       0   1.000   0.300   0.000      0.       0

      **********        **********        **********        **********        **********

                                 COMBINE HYDROGRAPHS
                   ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                      38       3       0       0       0       0       0       0       0

      **********        **********        **********        **********        **********

                              SUB-AREA RUNOFF COMPUTATION
                   ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                      39       0       0       0       0       0       0       0       0

                                  HYDROGRAPH DATA
          IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
              1       0  132.00    0.00 2740.00    0.00   0.000       0       0       0

                                    PRECIP DATA
                SPFE     PMS      R6     R12     R24     R48     R72     R96
                0.00   20.60   42.00   56.00   66.00   77.00   84.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                                     LOSS DATA
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AD-A093 025 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/6 13/13
NATIONAL DAM SAFETY PROGRAM. PALMER FALLS DAM, UPPER HUDSON RIV--ETC(U)
AUG 80 J B STETSON DACW51-79-C-0001
UNCLASSIFIED NY-145 NL

3 of 3

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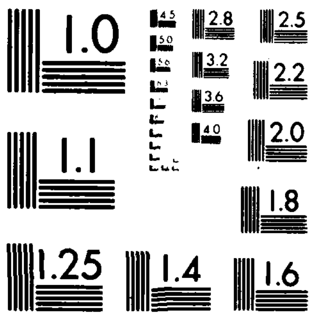

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

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     LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
         0    0.00    0.00    1.00    0.00    0.00    1.00    1.00    0.07    0.00    0.00

                                   UNIT HYDROGRAPH DATA
                            TC= 16.09     R= 10.13     NTA=  0

                                      RECESSION DATA
                      STRTQ=   240.00     QRCSN= 1750.00     RTIOR= 1.30

       UNIT HYDROGRAPH 63 END-OF-PERIOD ORDINATES, LAG=  14.02 HOURS, CP= 0.71  VOL= 1.00
        68.       328.       665.      1056.      1482.      1930.      2393.      2864.      3317.      3705.
      4006.      4222.      4356.      4407.      4369.      4221.      3923.      3557.      3222.      2919.
      2644.      2396.      2170.      1966.      1781.      1614.      1462.      1324.      1200.      1087.
       985.       892.       808.       732.       663.       601.       544.       493.       447.       405.
       367.       332.       301.       273.       247.       224.       203.       184.       166.       151.
       136.       124.       112.       101.        92.        83.        75.        68.        62.        56.
        51.        46.        42.

      0                                         END-OF-PERIOD FLOW
 MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q       MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                          SUM  16.02  11.85   4.18  1051720.
                                                                             ( 407.)( 301.)( 106.)(29781.37)

     **********          **********          **********          **********          **********

                                      HYDROGRAPH ROUTING

               ROUTE THRU INDIAN LAKE
                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                            39       1       0       0       0       0       1       0       0
                                             ROUTING DATA
                 QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                   0.0   0.000    0.00       1       0       0       0               0

                         NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                             1       0       0   0.000   0.000   0.000 106560.       0

STORAGE       0.00    36210.00    92880.00   106560.00   114350.00   118250.00   123060.00   128100.00   134100.00

OUTFLOW       0.00        0.00        0.00        0.00      700.00     1440.00     2340.00     3370.00     4525.00

     **********          **********          **********          **********          **********

                                      HYDROGRAPH ROUTING
                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                          3940       1       0       0       0       0       0       0       0
                                             ROUTING DATA
                 QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                   0.0   0.000    0.00       0       0       0       0               0
```

```
              NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISFRAT
                  1       0       0   1.600   0.300   0.000      0.       0

  **********    **********    **********    **********    **********

                        SUB-AREA RUNOFF COMPUTATION
              ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                 40       0       0       0       0       0       0       0       0

                            HYDROGRAPH DATA
        IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
            1       0   72.00    0.00 2740.00    0.00   0.000       0       0       0

                             PRECIP DATA
            SPFE     PMS      R6     R12     R24     R48     R72     R96
            0.00   20.60   42.00   56.00   66.00   77.00   84.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                              LOSS DATA
     LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
         0    0.00    0.00    1.00    0.00    0.00    1.00    1.00    0.07    0.00    0.00

                         UNIT HYDROGRAPH DATA
                   TC= 15.27     R= 17.66     NTA=  0

                            RECESSION DATA
               STRTQ=  110.00    QRCSN=  800.00    RTIOR= 1.30

     UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG=  14.43 HOURS, CP= 0.53  VOL= 0.99
       30.      114.      235.      379.      539.      713.      896.     1086.     1268.     1425.
     1555.     1657.     1729.     1770.     1772.     1718.     1627.     1538.     1453.     1373.
     1297.     1226.     1159.     1095.     1034.      977.      924.      873.      825.      779.
      736.      696.      658.      621.      587.      555.      524.      495.      468.      442.
      418.      395.      373.      353.      333.      315.      298.      281.      266.      251.
      237.      224.      212.      200.      189.      179.      169.      160.      151.      142.
      135.      127.      120.      114.      107.      101.       96.       91.       86.       81.
       76.       72.       68.       64.       61.       58.       54.       51.       49.       46.
       43.       41.       39.       37.       35.       33.       31.       29.       28.       26.
       25.       23.       22.       21.       20.       19.       18.       17.       16.       15.

0                                  END-OF-PERIOD FLOW
 MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q      MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                        SUM  16.02  11.85   4.18   559398.
                                                                           ( 407.)( 301.)( 106.)(15840.37)

  **********    **********    **********    **********    **********
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                         COMBINE HYDROGRAPHS
        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
           40       3       0       0       0       0       0       0       0

**********        **********        **********        **********        **********

                         HYDROGRAPH ROUTING

  ROUTE TO 1041
        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
         4041       1       0       0       0       0       1       0       0
                           ROUTING DATA
  QLOSS  CLOSS     AVG    IRES   ISAME    IOPT    IPMP           LSTR
    0.0  0.000    0.00       0       0       0       0              0

        NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
            2       0       0   2.120   0.200   0.000      0.       0

**********        **********        **********        **********        **********

                     SUB-AREA RUNOFF COMPUTATION
        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
           41       0       0       0       0       0       0       0       0

                          HYDROGRAPH DATA
   IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
       1       0  169.00    0.00 2740.00    0.00   0.000       0       0       0

                            PRECIP DATA
           SPFE     PMS      R6     R12     R24     R48     R72     R96
           0.00   20.60   42.00   56.00   66.00   77.00   84.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                             LOSS DATA
  LROPT  STRKR  DLTKR  RTIOL  ERAIN  STRKS  RTIOK  STRTL  CNSTL  ALSMX  RTIMP
      0   0.00   0.00   1.00   0.00   0.00   1.00   1.00   0.07   0.00   0.00

                       UNIT HYDROGRAPH DATA
                TC= 18.04     R= 13.00    NTA=  0

                           RECESSION DATA
             STRTQ=  290.00     QRCSN= 2300.00    RTIOR= 1.30

    UNIT HYDROGRAPH 79 END-OF-PERIOD ORDINATES, LAG=  16.12 HOURS, CP= 0.67  VOL= 1.00
      75.     280.     572.     915.    1293.    1696.    2117.    2552.    2954.    3425.
    3805.    4116.    4359.    4538.    4650.    4693.    4661.    4533.    4276.    3960.
    3666.    3395.    3143.    2911.    2695.    2495.    2310.    2139.    1981.    1834.
    1698.    1572.    1456.    1348.    1248.    1156.    1070.     991.     918.     850.
     787.     728.     674.     624.     578.     535.     496.     459.     425.     394.
     364.     337.     312.     289.     268.     248.     230.     213.     197.     182.
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   169.     156.     145.     134.     124.     115.     106.      98.      91.      84.
    78.      72.      67.      62.      57.      53.      49.      46.      42.

       0                                     END-OF-PERIOD FLOW
 MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q      MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                          SUM  16.02  11.85   4.18  1336531.
                                                                             ( 407.)( 301.)( 106.)(37846.30)


       **********        **********         **********         **********         **********

                                          COMBINE HYDROGRAPHS
                  ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                     41        2        0        0        0        0        0        0        0

       **********        **********         **********         **********         **********

                                           HYDROGRAPH ROUTING

             ROUTE TO CONFLUENCE WITH SCHROON RIVER
                  ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                   4143        1        0        0        0        0        1        0        0
                                             ROUTING DATA
            QLOSS   CLOSS      AVG     IRES    ISAME     IOPT     IPMP              LSTR
              0.0   0.000     0.00        0        0        0        0                 0

                  NSTPS    NSTDL      LAG    AMSKK        X      TSK    STORA   ISPRAT
                      3        0        0    2.080    0.200    0.000       0.        0

       **********        **********         **********         **********         **********

                                        SUB-AREA RUNOFF COMPUTATION
                  ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                    142        0        0        0        0        0        0        0        0

                                            HYDROGRAPH DATA
          IHYDG     IUHG    TAREA     SNAP    TRSDA    TRSPC    RATIO    ISNOW    ISAME    LOCAL
              1        0   313.00     0.00  2740.00     0.00    0.000        0        0        0

                                              PRECIP DATA
                    SPFE      PMS       R6      R12      R24      R48      R72      R96
                    0.00    20.60    42.00    56.00    66.00    77.00    84.00     0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                                               LOSS DATA
          LROPT    STRKR    DLTKR    RTIOL    ERAIN    STRKS    RTIOK    STRTL    CNSTL    ALSMX    RTIMP
              0     0.00     0.00     1.00     0.00     0.00     1.00     2.00     0.07     0.00     0.00

                                         UNIT HYDROGRAPH DATA
                            TC= 22.15      R= 17.72      NTA=  0
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```
                                        RECESSION DATA
                          STRTQ=  600.00    QRCSN= 4300.00    RTIOR= 1.30

                UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG=  20.09 HOURS, CP= 0.64  VOL= 0.99
           75.       284.       583.       940.      1338.      1766.      2223.      2697.      3186.      3687.
         4198.      4700.      5160.      5559.      5897.      6176.      6395.      6555.      6654.      6687.
         6647.      6515.      6250.      5912.      5587.      5280.      4991.      4717.      4458.      4213.
         3962.      3763.      3557.      3362.      3177.      3003.      2838.      2682.      2535.      2396.
         2264.      2140.      2023.      1912.      1807.      1708.      1614.      1525.      1442.      1362.
         1288.      1217.      1150.      1087.      1027.       971.       918.       867.       820.       775.
          732.       692.       654.       618.       584.       552.       522.       493.       466.       441.
          416.       394.       372.       352.       332.       314.       297.       280.       265.       251.
          237.       224.       211.       200.       189.       179.       169.       159.       151.       142.
          135.       127.       120.       114.       107.       102.        96.        91.        86.        81.

     0                                      END-OF-PERIOD FLOW
  MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q       MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                             SUM  16.02  11.19   4.83  2308619.
                                                                                ( 407.)( 284.)( 123.)(65372.75)


         **********          **********          **********          **********          **********
                                          HYDROGRAPH ROUTING

                ROUTE THRU SCHROON LAKE
                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                           142       1       0       0       0       0       1       0       0
                                          ROUTING DATA
                 QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                   0.0   0.000    0.00       0       0       0       0               0

                         NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                             1       0       0  55.000   0.000   0.000      0.       0

         **********          **********          **********          **********          **********

                                     SUB-AREA RUNOFF COMPUTATION
                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                           242       0       0       0       0       0       0       0       0

                                          HYDROGRAPH DATA
                 IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                     1       0   99.00    0.00 2740.00    0.00   0.000       0       0       0

                                          PRECIP DATA
                          SPFE     PMS      R6     R12     R24     R48     R72     R96
                          0.00   20.60   42.00   56.00   66.00   77.00   84.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926
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```
                                         LOSS DATA
     LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
        0     0.00    0.00    1.00    0.00    0.00    1.00    2.00    0.07    0.00    0.00

                                    UNIT HYDROGRAPH DATA
                              TC= 15.56      R= 11.43     NTA=  0

                                       RECESSION DATA
                          STRTQ=  152.00      QRCSN= 1100.00     RTIOR= 1.30

       UNIT HYDROGRAPH 69 END-OF-PERIOD ORDINATES, LAG=  13.82 HOURS, CP= 0.66  VOL= 1.00
         62.       231.       470.       750.      1056.      1380.      1717.      2062.      2387.      2660.
       2873.      3026.      3120.      3153.      3115.      2974.      2751.      2520.      2309.      2115.
       1936.      1776.      1627.      1490.      1366.      1251.      1146.      1050.       962.       881.
        808.       740.       678.       621.       569.       521.       478.       438.       401.       367.
        336.       308.       282.       259.       237.       217.       199.       182.       167.       153.
        140.       128.       118.       108.        99.        91.        83.        76.        70.        64.
         58.        54.        49.        45.        41.        38.        35.        32.        29.

    0                                  END-OF-PERIOD FLOW
MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q       MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                       SUM  16.02  11.19   4.83   739188.
                                                                          ( 407.)( 284.)( 123.)(20931.45)

       **********          **********          **********          **********          **********

                                    COMBINE HYDROGRAPHS
                   ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                     142       2       0       0       0       0       0       0       0

       **********          **********          **********          **********          **********

                                     HYDROGRAPH ROUTING
                   ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                   14242       1       0       0       0       0       0       0       0
                                        ROUTING DATA
            QLOSS  CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
              0.0  0.000    0.00       0       0       0       0               0

                   NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                       3       0       0   1.510   0.100   0.000      0.       0

       **********          **********          **********          **********          **********

                                 SUB-AREA RUNOFF COMPUTATION
                   ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                      42       0       0       0       0       0       0       0       0
```

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                                          HYDROGRAPH DATA
               IHYDG    IUHG   TAREA    SNAF   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                   1       C  115.CO    0.CC 2740.00    0.0C   C.000C       0       0       0

                                            PRECIP DATA
                          SPFE     PMS      R6     R12     R24     R48     R72     R96
                          C.0C   20.6C   42.CC   56.00   66.00   77.00   84.00    C.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                                             LOSS DATA
           LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
               C    0.00    G.0C    1.0C    C.00    0.0C    1.00    2.0C    C.07    C.CC    C.CC

                                         UNIT HYDROGRAPH DATA
                                     TC= 15.13     R=  8.99    NTA=  C

                                           RECESSION DATA
                              STRTQ=  180.CC    QRCSN= 1350.00     RTIOR= 1.30

            UNIT HYDROGRAPH 56 END-OF-PERIOD ORDINATES, LAG=  13.05 HOURS, CP= 0.72  VOL= 1.CC
          94.      350.      707.     1118.     1562.     2027.     25C2.     2979.     34C8.     3746.
        3988.     4139.     4199.     4164.     4013.     3703.     3317.     2967.     2655.     2375.
        2125.     1901.     17C1.     1521.     1361.     1218.     1069.      975.      872.      78C.
         698.      624.      558.      500.      447.      400.      358.      320.      286.      256.
         229.      205.      183.      164.      147.      131.      117.      105.       94.       84.
          75.       67.       60.       54.       48.       43.

       0                                   END-OF-PERIOD FLOW
   MO.DA  HR.MN  PERIOD    RAIN   EXCS   LCSS    COMP Q      MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                            SUM  16.02  11.19   4.83  865CC4.
                                                                               ( 4C7.)( 284.)( 123.)(24494.16)


       **********        **********        **********        **********        **********

                                         HYDROGRAPH ROUTING
                          ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                             42       1       0       0       0       0       0       0       0
                                            ROUTING DATA
                  QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                    C.0   0.CC0    C.C0       0       0       0       0               C

                          NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                              1       0       0  45.C00   0.000   0.C00      C.       0

       **********        **********        **********        **********        **********

                                        COMBINE HYDROGRAPHS
                          ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                             42       2       0       0       0       0       0       C       0
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**********          **********          **********          **********          **********

                                 HYDROGRAPH ROUTING
                  ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                   4243        1        0        0        0        0        0        0        0
                                     ROUTING DATA
          QLOSS    CLOSS      AVG     IRES    ISAME     IOPT     IPMP             LSTR
            0.0    0.000     0.00        0        0        0        0                0

                  NSTPS    NSTDL      LAG    AMSKK        X      TSK    STORA   ISPRAT
                      5        0        0    1.630    0.300    0.000      0.        0

**********          **********          **********          **********          **********

                              SUB-AREA RUNOFF COMPUTATION
                  ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                     43        0        0        0        0        0        0        0        0

                                   HYDROGRAPH DATA
        IHYDG     IUHG    TAREA     SNAP    TRSDA    TRSPC    RATIO    ISNOW    ISAME    LOCAL
            1        0   227.00     0.00  2740.00     0.00    0.000        0        0        0

                                     PRECIP DATA
             SPFE      PMS       R6      R12      R24      R48      R72      R96
             0.00    20.60    42.00    56.00    66.00    77.00    84.00     0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                                      LOSS DATA
     LROPT    STRKR    DLTKR    RTIOL    ERAIN    STRKS    RTIOK    STRTL    CNSTL    ALSMX    RTIMP
         0     0.00     0.00     1.00     0.00     0.00     1.00     1.00     0.07     0.00     0.00

                                UNIT HYDROGRAPH DATA
                         TC= 18.54      R= 11.07     NTA=  0

                                    RECESSION DATA
                     STRTQ=  400.00     QRCSN= 3100.00     RTIOR= 1.30

          UNIT HYDROGRAPH 69 END-OF-PERIOD ORDINATES, LAG=  15.98 HOURS, CP= 0.71  VOL= 1..0
     112.      419.      854.     1359.     1913.     2496.     3105.     3725.     4354.     4971.
    5522.     5967.     6311.     6556.     6704.     6755.     6704.     6534.     6183.     5693.
    5201.     4752.     4341.     3966.     3623.     3310.     3024.     2762.     2524.     2306.
    2106.     1924.     1758.     1606.     1467.     1340.     1224.     1119.     1022.      934.
     853.      779.      712.      650.      594.      543.      496.      453.      414.      378.
     345.      316.      288.      263.      241.      220.      201.      183.      168.      153.
     140.      128.      117.      107.       97.       89.       81.       74.       68.

      0                                END-OF-PERIOD FLOW
MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q     MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q
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                                                                 SUM  16.02  11.85   4.18  1804963.
                                                                     ( 407.)( 301.)( 106.)(51110.81)

**********        **********        **********        **********        **********

                              COMBINE HYDROGRAPHS
                  ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                     43        3        0        0        0        0        0        0        0

**********        **********        **********        **********        **********

                               HYDROGRAPH ROUTING

         ROUTE TO 1044
                  ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                   4344        1        0        0        0        0        1        0        0
                                        ROUTING DATA
         QLOSS    CLOSS      AVG     IRES    ISAME     IOPT     IPMP              LSTR
           0.0    0.000     0.00        0        0        0        0                 0

                  NSTPS    NSTDL      LAG    AMSKK        X      TSK    STORA   ISPRAT
                      6        0        0    1.590    0.200    0.000       0.        0

**********        **********        **********        **********        **********

                           SUB-AREA RUNOFF COMPUTATION
                  ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                     44        0        0        0        0        0        0        0        0

                                       HYDROGRAPH DATA
      IHYDG     IUHG    TAREA     SNAP    TRSDA    TRSPC    RATIO    ISNOW    ISAME    LOCAL
          1        0   118.00     0.00  2740.00     0.00    0.000        0        0        0

                                         PRECIP DATA
             SPFE      PMS       R6      R12      R24      R48      R72      R96
             0.00    20.60    42.00    56.00    66.00    77.00    84.00     0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                                          LOSS DATA
    LROPT    STRKR    DLTKR    RTIOL    ERAIN    STRKS    RTIOK    STRTL    CNSTL    ALSMX    RTIMP
        0     0.00     0.00     1.00     0.00     0.00     1.00     1.00     0.07     0.00     0.00

                                   UNIT HYDROGRAPH DATA
                          TC= 15.80      R=  9.86     NTA=  0

                                     RECESSION DATA
                      STRTQ=  185.00     QRCSN= 1500.00     RTIOR= 1.30

      UNIT HYDROGRAPH 61 END-OF-PERIOD ORDINATES, LAG=  13.55 HOURS, CP= 0.70  VOL= 1.00
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```
   83.     309.     626.     993.    1392.    1812.    2244.    2683.    3099.    3446.
 3711.    3895.    4001.    4028.    3966.    3784.    3478.    3143.    2839.    2565.
 2318.    2094.    1892.    1709.    1544.    1395.    1260.    1139.    1029.     930.
  840.     759.     686.     619.     560.     506.     457.     413.     373.     337.
  304.     275.     248.     224.     203.     183.     166.     150.     135.     122.
  110.     100.      90.      81.      73.      66.      60.      54.      49.      44.
   40.

      0                                         END-OF-PERIOD FLOW
 MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q       MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                          SUM  16.02  11.85   4.18   938363.
                                                                             ( 407.)( 301.)( 106.)(26571.46)

        **********          **********          **********          **********          **********

                                         COMBINE HYDROGRAPHS

                COMBINE 2 HYDROGRAPHS AT HADLEY, NY
                             ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                                44       2       0       0       0       0       1       0       0

        **********          **********          **********          **********          **********

                                      SUB-AREA RUNOFF COMPUTATION
                             ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                                45       0       0       0       0       0       0       0       0

                                           HYDROGRAPH DATA
                     IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                         1       0  114.00    0.00 2740.00    0.00   0.000       0       0       0

                                             PRECIP DATA
                          SPFE     PMS      R6     R12     R24     R48     R72     R96
                          0.00   20.60   42.00   56.00   66.00   77.00   64.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                                              LOSS DATA
                 LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
                     0    0.00    0.00    1.00    0.00    0.00    1.00    1.00    0.07    0.00    0.00

                                         UNIT HYDROGRAPH DATA
                                  TC= 16.16     R= 11.77     NTA=  0

                                            RECESSION DATA
                              STRTQ=  160.00     QRCSN= 1350.00     RTIOR= 1.30

           UNIT HYDROGRAPH 72 END-OF-PERIOD ORDINATES, LAG=  14.40 HOURS, CP= 0.67  VOL= 1.00
   65.     244.     498.     795.    1120.    1466.    1825.    2194.    2554.    2869.
 3120.    3309.    3438.    3504.    3503.    3421.    3224.    2965.    2723.    2501.
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   2298.     2110.     1936.     1780.     1635.     1502.     1380.     1267.     1164.     1069.
    982.      902.      828.      761.      699.      642.      590.      542.      497.      457.
    420.      385.      354.      325.      299.      274.      252.      231.      213.      195.
    179.      165.      151.      139.      128.      117.      108.       99.       91.       83.
     77.       70.       65.       59.       55.       50.       46.       42.       39.       36.
     33.       30.

  0                                       END-OF-PERIOD FLOW
MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q      MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                           SUM  16.02  11.85   4.18   900413.
                                                                              ( 407.)( 301.)( 106.)(25496.83)

      **********          **********          **********          **********          **********

                                          HYDROGRAPH ROUTING

              ROUTE TO 1046
                        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                         4546       1       0       0       0       0       1       0       0
                                           ROUTING DATA
              QLOSS     CLOSS     AVG    IRES   ISAME    IOFT    IPMP            LSTR
                0.0     0.000    0.00       0       0       0       0               0

                        NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                            2       0       0   1.290   0.300   0.000      0.       0

      **********          **********          **********          **********          **********

                                    SUB-AREA RUNOFF COMPUTATION
                        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                           46       0       0       0       0       0       0       0       0

                                          HYDROGRAPH DATA
           IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
               1       0  377.00    0.00 2740.00    0.00   0.000       0       0       0

                                           PRECIP DATA
                    SPFE     PMS      R6     R12     R24     R48     R72     R96
                    0.00   20.60   42.00   56.00   66.00   77.00   84.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                                            LOSS DATA
          LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
              0    0.00    0.00    1.00    0.00    0.00    1.00    1.00    0.07    0.00    0.00

                                       UNIT HYDROGRAPH DATA
                               TC= 24.41     R= 26.10    NTA=  0

                                          RECESSION DATA
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                    STRTQ=  745.00     QRCSN= 5500.00     RTIOR= 1.30

          UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG=  23.01 HOURS, CP= 0.56  VOL= 0.96
      54.       203.       420.       682.       977.      1299.      1644.      2007.      2386.      2778.
    3182.      3596.      4010.      4402.      4755.      5069.      5345.      5581.      5778.      5934.
    6048.      6117.      6134.      6090.      5951.      5741.      5526.      5318.      5118.      4925.
    4740.      4562.      4391.      4226.      4067.      3914.      3767.      3625.      3489.      3358.
    3231.      3110.      2993.      2880.      2772.      2668.      2568.      2471.      2378.      2289.
    2203.      2120.      2040.      1964.      1890.      1819.      1750.      1685.      1621.      1560.
    1502.      1445.      1391.      1339.      1288.      1240.      1193.      1148.      1105.      1064.
    1024.       985.       948.       912.       878.       845.       813.       783.       753.       725.
     698.       672.       646.       622.       599.       576.       554.       534.       514.       494.
     676.       458.       441.       424.       408.       393.       378.       364.       350.       337.

       0                                     END-OF-PERIOD FLOW
 MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q       MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                          SUM  16.02  11.85   4.18  2846094.
                                                                              ( 407.)( 301.)( 106.)(80592.33)


      **********          **********          **********          **********          **********

                                         COMBINE HYDROGRAPHS
                     ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                        46       2       0       0       0       0       0       0       0

      **********          **********          **********          **********          **********

                                          HYDROGRAPH ROUTING

                ROUTE TO 1147
                     ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                      4647       1       0       0       0       0       1       0       0
                                            ROUTING DATA
              QLOSS  CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                0.0  0.000    0.00       0       0       0       0               0

                     NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                         2       0       0   1.470   0.300   0.000     0.        0

      **********          **********          **********          **********          **********

                                     SUB-AREA RUNOFF COMPUTATION
                     ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                        47       0       0       0       0       0       0       0       0

                                           HYDROGRAPH DATA
            IHYDG    IUHG   TAREA     SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                1       0  564.00     0.00 2740.00    0.00   0.000       0       0       0
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                                             PRECIP DATA
                          SPFE      PMS       R6       R12      R24      R48      R72      R96
                          C.OC     20.6C    42.0C    56.00    66.00    77.00    84.00     C.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                                              LOSS DATA
               LROPT    STRKR    DLTKR    RTIOL    ERAIN    STRKS    RTIOK    STRTL    CNSTL    ALSMX    RTIMP
                   C     0.00     0.0C     1.0C     0.00     0.00     1.00     1.0C     0.07     C.CC     0.08

                                          UNIT HYDROGRAPH DATA
                                   TC= 24.16      R= 14.73     NTA=  C

                                            RECESSION DATA
                               STRTQ= 12C0.CC     QRCSN= 7600.00     RTIOR= 1.30

                UNIT HYDROGRAPH 92 END-OF-PERIOD ORDINATES, LAG=  20.91 HOURS, CP= 0.71  VOL= 1.CC
              142.       535.      1097.      1760.      2496.      3284.      4113.      4571.      5850.      6746.
             7651.      8564.      9453.     10257.     10943.     11515.     11977.     12332.     12560.     12721.
            12754.     12672.     12461.     12085.     11470.     10726.     10021.      9363.      8749.      8174.
             7637.      7136.      6667.      6230.      5821.      5438.      5081.      4748.      4436.      4145.
             3873.      3618.      3381.      3159.      2951.      2758.      2576.      2407.      2249.      2102.
             1964.      1835.      1714.      1602.      1496.      1398.      1306.      1221.      1140.      1066.
              996.       930.       869.       812.       759.       709.       662.       619.       578.       54C.
              505.       472.       441.       412.       385.       359.       336.       314.       293.       274.
              256.       239.       223.       209.       195.       182.       170.       159.       149.       139.
              130.       121.

         0                                        END-OF-PERIOD FLOW
     MO.DA   HR.MN   PERIOD    RAIN    EXCS    LOSS     COMP Q        MO.DA   HR.MN   PERIOD    RAIN    EXCS    LOSS     COMP Q

                                                                                      SUM   16.02   12.18    3.84  4558318.
                                                                                          ( 407.)( 3C9.)(  98.)($129C77.)

            **********          **********          **********          **********          **********

                                              COMBINE HYDROGRAPHS
                                   ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                                      47        2        0        0        0        0        0        0        0

            **********          **********          **********          **********          **********

                                               HYDROGRAPH ROUTING

                         ROUTE TO 1047 THRU GREAT SACANDAGA LAKE
                                   ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                                      47        1        0        0        0        0        1        0        0
                                                  ROUTING DATA
                          QLOSS    CLOSS      AVG     IRES    ISAME     IOPT     IPMP              LSTR
                            C.C    0.C00     C.C0        1        0        0        0                 0
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                    NSTPS   NSTDL     LAG   AMSKK       X      TSK   STORA  ISFRAT
                        1       0       0   0.000   0.000    C.C00 7603C2.       0

STORAGE   435941.0C   655418.CC   7C73CC.0C   733700.00   765611.00   814279.00   841598.CC   941230.00  1003213.C0

OUTFLOW     7275.00     7848.0C     7970.0C     8029.00     822C.0C    11971.00    23187.CC    41164.0C    52464.CC

      **********        **********        **********        **********        **********

                         SUB-AREA RUNOFF COMPUTATION
                    ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                       48       0       0       0       0       0       0       0       0

                                  HYDROGRAPH DATA
             IHYDG    IUHG   TAREA    SNAF   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                 1       C    3.C0    C.CC 2740.00    0.0C   C.00C       0       0       0

                                    PRECIP DATA
                 SPFE     PMS      R6     R12     R24     R48     R72     R96
                 C.0C   2C.6C   42.0C   56.00   66.00   77.00   84.00    C.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                                     LOSS DATA
         LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
             C    G.0C    G.0C    1.0C    C.00    0.0C    1.00    1.0C    0.07    C.CC    0.CC

                               UNIT HYDROGRAPH DATA
                           TC=  5.60     R=  3.92     NTA=  C

                                   RECESSION DATA
                      STRTQ=    5.CC    QRCSN=    5.00    RTIOR= 1.30

     UNIT HYDROGRAPH 24 END-OF-FERIOD ORDINATES, LAG=    4.78 HOURS, CP= 0.66  VOL= 1.CC
        Z3.       84.      163.      231.      266.      253.      2C7.      160.      124.       96.
        74.       57.       44.       34.       27.       21.       16.       12.       10.        7.
         6.        4.        3.        3.

        0                             END-OF-PERIOD FLOW
   MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q      MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP G

                                                                          SUM   16.02  11.85   4.18    23123.
                                                                              ( 4C7.)( 3C1.)( 106.)(  654.77)

      **********        **********        **********        **********        **********

                                COMBINE HYDROGRAPHS

             COMBINE 3 HYDROGRAPHS AT 1048 - HUDSON R. BELOW SACANDAGA R.
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           ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
              48       3       0       0       0       0       1       0       0

**********         **********         **********         **********         **********

                                    HYDROGRAPH ROUTING

      ROUTE TO PALMER FALLS DAM
           ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
           48257       1       0       0       0       0       1       0       0
                                   ROUTING DATA
    QLOSS  CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
      C.0  0.C00    0.C0       0       0       0       0               0

           NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
               5       0       0   2.270   0.2C0   C.CC0      C.       C

**********         **********         **********         **********         **********

                               SUB-AREA RUNOFF COMPUTATION

      RUNOFF SUB-AREA 48A
           ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
           257.5       0       0       0       0       0       1       0       0

                                    HYDROGRAPH DATA
   IHYDG    IUHG   TAREA    SNAF   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
       1       0   35.20    0.CC 2740.00    0.GC   C.00C       C       0       0

                                      PRECIP DATA
                 SPFE     PMS      R6     R12     R24     R48     R72     R96
                 0.0C   20.6C   42.0C   56.00   66.CC   77.0C   84.00    C.00
TRSPC COMPUTED BY THE PROGRAM IS 0.926

                                       LOSS DATA
   LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
       C    0.0C    0.0C    1.0C    C.00    0.0C    1.00    1.0C    0.07    0.CC    0.CC

                                 UNIT HYDROGRAPH DATA
                             TC= 11.30     R=  7.64     NTA=   C

                                    RECESSION DATA
                        STRTQ=    45.CC    QRCSN=  350.00    RTIOR= 1.30

    UNIT HYDROGRAPH 47 END-OF-PERIOD ORDINATES, LAG=   9.9C HOURS, CP= 0.69  VOL= 1.CC
       52.      192.      387.      608.      844.     1C86.     13C4.     1466.     1567.     16C9.
     1584.     1466.     1295.     1136.      996.      874.      766.      672.      590.      517.
      454.      398.      349.      306.      269.      236.      2C7.      181.      159.      139.
      122.      107.       94.       83.       72.       64.       56.       49.       43.       38.
       33.       29.       25.       22.       2C.       17.       15.
```

```
 0                                        END-OF-PERIOD FLOW
MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q       MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                               SUM  16.02  11.85   4.18   278453.
                                                                                  ( 407.)( 301.)( 106.)( 7884.90)

        **********         **********         **********         **********         **********

                                              COMBINE HYDROGRAPHS

                            COMBINE 2 HYDROGRAPHS AT PALMER FALLS DAM
                                     ISTAQ     ICOMP     IECON     ITAPE      JPLT      JPRT     INAME    ISTAGE     IAUTO
                                     257.5         2         0         0         0         0         1         0         0

        **********         **********         **********         **********         **********

                                              HYDROGRAPH ROUTING

                            ROUTE OVER PALMER FALLS DAM
                                     ISTAQ     ICOMP     IECON     ITAPE      JPLT      JPRT     INAME    ISTAGE     IAUTO
                                    1257.5         1         0         0         0         0         1         0         0
                                                              ROUTING DATA
                            QLOSS     CLOSS       AVG      IRES     ISAME      IOPT      IPMP                LSTR
                              0.0     0.000      0.00         1         0         0         0                   0

                                     NSTPS     NSTDL       LAG     AMSKK         X       TSK     STORA    ISPRAT
                                         1         0         0     0.000     0.000     0.000     -517.       -1

STAGE       517.17      518.00      519.00      520.00      521.00      522.00      523.00      524.00      525.00
            528.00      530.00      532.00      534.00      536.00      538.00      543.00      548.00      553.00

FLOW          0.00      811.00     2740.00     5355.00     8560.00    12120.00    16070.00    20380.00    25015.00
          41310.00    54060.00    68170.00    83610.00   100360.00   118420.00   165800.00   216200.00   270850.00

CAPACITY=        0.          3.         11.         26.         46.         74.        107.        148.        195.        250.
               279.        309.        376.        450.        522.        752.       1264.

ELEVATION=     480.        484.        488.        492.        496.        500.        504.        508.        512.        516.
               517.        518.        522.        526.        530.        540.        560.

                                  CREL     SPWID      COQW      EXPW     ELEVL      COQL     CAREA      EXPL
                                 517.2       0.0       0.0       0.0       0.0       0.0       0.0       0.0

                                                          DAM DATA
                                                 TOPEL      COQD      EXPD    DAMWID
                                                 531.7       2.6       1.5       80.

PEAK OUTFLOW IS    52661. AT TIME  85.00 HOURS
```

```
PEAK OUTFLOW IS    84965. AT TIME  86.00 HOURS
PEAK OUTFLOW IS   113023. AT TIME  86.00 HOURS
PEAK OUTFLOW IS   140777. AT TIME  86.00 HOURS
PEAK OUTFLOW IS   168640. AT TIME  86.00 HOURS
PEAK OUTFLOW IS   225123. AT TIME  86.00 HOURS
PEAK OUTFLOW IS   282567. AT TIME  86.00 HOURS

          **********         **********         **********         **********         **********
```

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 0.20	RATIO 2 0.30	RATIO 3 0.40	RATIO 4 0.50	RATIO 5 0.60	RATIO 6 0.80	RATIO 7 1.00
HYDROGRAPH AT	36	192.00	1	7661.	11491.	15321.	19152.	22982.	30643.	38303.
		(497.27)	(	216.93)(	325.39)(	433.85)(	542.31)(	650.78)(	867.70)(	1084.63)(
ROUTED TO	3638	192.00	1	7585.	11378.	15170.	18963.	22755.	30341.	37926.
		(497.27)	(	214.79)(	322.18)(	429.57)(	536.97)(	644.36)(	859.15)(	1073.93)(
HYDROGRAPH AT	38	67.00	1	3541.	5312.	7083.	8854.	10624.	14166.	17707.
		(173.53)	(	100.28)(	150.42)(	200.56)(	250.70)(	300.84)(	401.13)(	501.41)(
HYDROGRAPH AT	37	160.00	1	6614.	9920.	13227.	16534.	19841.	26455.	33068.
		(414.40)	(	187.28)(	280.92)(	374.55)(	468.19)(	561.83)(	749.11)(	936.39)(
ROUTED TO	3738	160.00	1	6600.	9900.	13200.	16500.	19800.	26400.	33000.
		(414.40)	(	186.89)(	280.34)(	373.78)(	467.23)(	560.67)(	747.56)(	934.45)(
3 COMBINED	38	419.00	1	16712.	25069.	33425.	41781.	50137.	66850.	83562.
		(1085.20)	(	473.24)(	709.86)(	946.49)(	1183.11)(	1419.73)(	1892.97)(	2366.21)(
HYDROGRAPH AT	39	132.00	1	8436.	12654.	16872.	21090.	25308.	33744.	42180.
		(341.88)	(	238.88)(	358.32)(	477.76)(	597.20)(	716.63)(	955.51)(	1194.39)(
ROUTED TO	39	132.00	1	1595.	2684.	3796.	5022.	6513.	9441.	12343.
		(341.88)	(	45.18)(	75.99)(	107.48)(	142.21)(	184.42)(	267.35)(	349.52)(
ROUTED TO	3940	132.00	1	1595.	2682.	3793.	5017.	6506.	9430.	12331.
		(341.88)	(	45.16)(	75.94)(	107.41)(	142.07)(	184.22)(	267.02)(	349.17)(
HYDROGRAPH AT	40	72.00	1	3509.	5263.	7017.	8771.	10526.	14034.	17543.
		(186.48)	(	99.35)(	149.03)(	198.70)(	248.38)(	298.05)(	397.41)(	496.76)(
3 COMBINED	40	623.00	1	20687.	31387.	42091.	52833.	63537.	85536.	107645.
		(1613.55)	(	585.80)(	888.79)(	1191.87)(	1496.07)(	1799.17)(	2422.10)(	3048.15)(
ROUTED TO	4041	623.00	1	20278.	30747.	41247.	51756.	62322.	83919.	105592.
		(1613.55)	(	574.20)(	870.65)(	1167.97)(	1465.56)(	1764.76)(	2376.33)(	2990.04)(
HYDROGRAPH AT	41	169.00	1	9255.	13883.	18511.	23139.	27766.	37022.	46277.
		(437.71)	(	262.08)(	393.13)(	524.17)(	655.21)(	786.25)(	1048.34)(	1310.42)(
2 COMBINED	41	792.00	1	27553.	41580.	55664.	69781.	83892.	112377.	141108.
		(2051.26)	(	780.23)(	1177.41)(	1576.23)(	1975.96)(	2375.55)(	3182.15)(	3995.74)(

ROUTED TO	4143	792.00	1	26750.	40369.	54039.	67735.	81447.	109143.	137040.
		(2051.26)	(	757.49)(	1143.13)(	1530.22)(	1918.03)(	2306.31)(	3090.58)(	3880.54)(
HYDROGRAPH AT	142	313.00	1	13413.	20120.	26827.	33533.	40240.	53653.	67066.
		(810.66)	(	379.82)(	569.73)(	759.64)(	949.56)(	1139.47)(	1519.29)(	1899.11)(
ROUTED TO	142	313.00	1	4659.	6989.	9319.	11648.	13978.	18637.	23297.
		(810.66)	(	131.94)(	197.91)(	263.88)(	329.85)(	395.82)(	527.75)(	659.69)(
HYDROGRAPH AT	242	99.00	1	5989.	8983.	11977.	14972.	17966.	23954.	29943.
		(256.41)	(	169.58)(	254.37)(	339.16)(	423.95)(	508.73)(	678.31)(	847.89)(
2 COMBINED	142	412.00	1	7641.	11462.	15283.	19103.	22924.	30565.	38207.
		(1067.07)	(	216.38)(	324.57)(	432.76)(	540.95)(	649.13)(	865.51)(	1081.89)(
ROUTED TO	14242	412.00	1	7405.	11108.	14811.	18514.	22216.	29622.	37027.
		(1067.07)	(	209.70)(	314.55)(	419.40)(	524.25)(	629.10)(	838.80)(	1048.50)(
HYDROGRAPH AT	42	115.00	1	7849.	11774.	15698.	19623.	23547.	31396.	39245.
		(297.85)	(	222.26)(	333.39)(	444.52)(	555.65)(	666.78)(	889.04)(	1111.31)(
ROUTED TO	42	115.00	1	2322.	3483.	4644.	5805.	6966.	9289.	11611.
		(297.85)	(	65.76)(	98.63)(	131.51)(	164.39)(	197.27)(	263.02)(	328.78)(
2 COMBINED	42	527.00	1	9580.	14371.	19161.	23951.	28741.	38322.	47902.
		(1364.91)	(	271.29)(	406.93)(	542.57)(	678.22)(	813.86)(	1085.15)(	1356.43)(
ROUTED TO	4243	527.00	1	9414.	14121.	18828.	23535.	28241.	37655.	47069.
		(1364.91)	(	266.57)(	399.85)(	533.14)(	666.42)(	799.71)(	1066.28)(	1332.85)(
HYDROGRAPH AT	43	227.00	1	13243.	19864.	26486.	33107.	39729.	52972.	66215.
		(587.92)	(	375.00)(	562.50)(	750.00)(	937.50)(	1125.00)(	1500.00)(	1874.99)(
3 COMBINED	43	1546.00	1	42654.	64193.	85790.	107417.	129053.	172531.	216194.
		(4004.09)	(	1207.82)(	1817.74)(	2429.31)(	3041.70)(	3654.38)(	4885.52)(	6121.93)(
ROUTED TO	4344	1546.00	1	41624.	62635.	83711.	104809.	125945.	168440.	211073.
		(4004.09)	(	1178.66)(	1773.62)(	2370.43)(	2967.85)(	3566.37)(	4769.67)(	5976.91)(
HYDROGRAPH AT	44	118.00	1	7672.	11509.	15345.	19181.	23017.	30689.	38362.
		(305.62)	(	217.26)(	325.88)(	434.51)(	543.14)(	651.77)(	869.02)(	1086.28)(
2 COMBINED	44	1664.00	1	43137.	64892.	86706.	108545.	130411.	174331.	218396.
		(4309.71)	(	1221.49)(	1837.54)(	2455.23)(	3073.64)(	3692.82)(	4936.51)(	6184.28)(
HYDROGRAPH AT	45	114.00	1	6783.	10175.	13566.	16958.	20349.	27132.	33915.
		(295.26)	(	192.07)(	288.11)(	384.15)(	480.18)(	576.22)(	768.30)(	960.37)(
ROUTED TO	4546	114.00	1	6722.	10083.	13444.	16806.	20167.	26889.	33611.
		(295.26)	(	190.35)(	285.53)(	380.70)(	475.88)(	571.06)(	761.41)(	951.76)(

HYDROGRAPH AT	46	377.00	1	12874.	19310.	25747.	32184.	38621.	51494.	64368.
		(976.42)		(364.54)(	546.81)(	729.08)(	911.35)(	1093.62)(	1458.16)(	1822.70)(
2 COMBINED	46	491.00	1	18901.	28352.	37802.	47253.	56703.	75604.	94505.
		(1271.68)		(535.22)(	802.83)(	1070.44)(	1338.05)(	1605.66)(	2140.87)(	2676.09)(
ROUTED TO	4647	491.00	1	18749.	28123.	37497.	46871.	56245.	74994.	93742.
		(1271.68)		(530.90)(	796.35)(	1061.80)(	1327.24)(	1592.69)(	2123.59)(	2654.49)(
HYDROGRAPH AT	47	564.00	1	26541.	39812.	53082.	66353.	79624.	106165.	132706.
		(1460.74)		(751.56)(	1127.34)(	1503.12)(	1878.90)(	2254.68)(	3006.25)(	3757.81)(
2 COMBINED	47	1055.00	1	45047.	67571.	90095.	112618.	135142.	180189.	225237.
		(2732.42)		(1275.60)(	1913.40)(	2551.20)(	3189.00)(	3826.79)(	5102.39)(	6377.99)(
ROUTED TO	47	1055.00	1	11681.	24027.	30988.	38128.	45336.	60531.	76263.
		(2732.42)		(330.76)(	680.36)(	877.49)(	1079.68)(	1283.76)(	1714.05)(	2159.52)(
HYDROGRAPH AT	48	3.00	1	385.	578.	771.	963.	1156.	1541.	1926.
		(7.77)		(10.91)(	16.37)(	21.82)(	27.28)(	32.73)(	43.64)(	54.55)(
3 COMBINED	48	2722.00	1	54127.	87817.	116176.	144686.	173285.	231285.	290341.
		(7049.90)		(1532.70)(	2486.69)(	3289.75)(	4097.05)(	4906.89)(	6549.26)(	8221.54)(
RCUTED TO	48257	2722.00	1	52616.	84870.	112892.	140605.	168433.	224856.	282238.
		(7049.90)		(1489.91)(	2403.25)(	3196.73)(	3981.47)(	4769.49)(	6367.20)(	7992.08)(
HYDROGRAPH AT	257.5	35.20	1	2845.	4268.	5691.	7113.	8536.	11381.	14227.
		(91.17)		(80.57)(	120.86)(	161.14)(	201.43)(	241.71)(	322.28)(	402.85)(
2 COMBINED	257.5	2757.20	1	52684.	84970.	113024.	140770.	168632.	225121.	282570.
		(7141.07)		(1491.84)(	2406.07)(	3200.49)(	3986.17)(	4775.13)(	6374.71)(	8001.47)(
RCUTED TO	1257.5	2757.20	1	52681.	84965.	113023.	140777.	168640.	225123.	282567.
		(7141.07)		(1491.76)(	2405.95)(	3200.45)(	3986.35)(	4775.35)(	6374.77)(	8001.41)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	517.17	517.17	531.70
STORAGE	284.	284.	561.
OUTFLOW	0.	0.	66053.

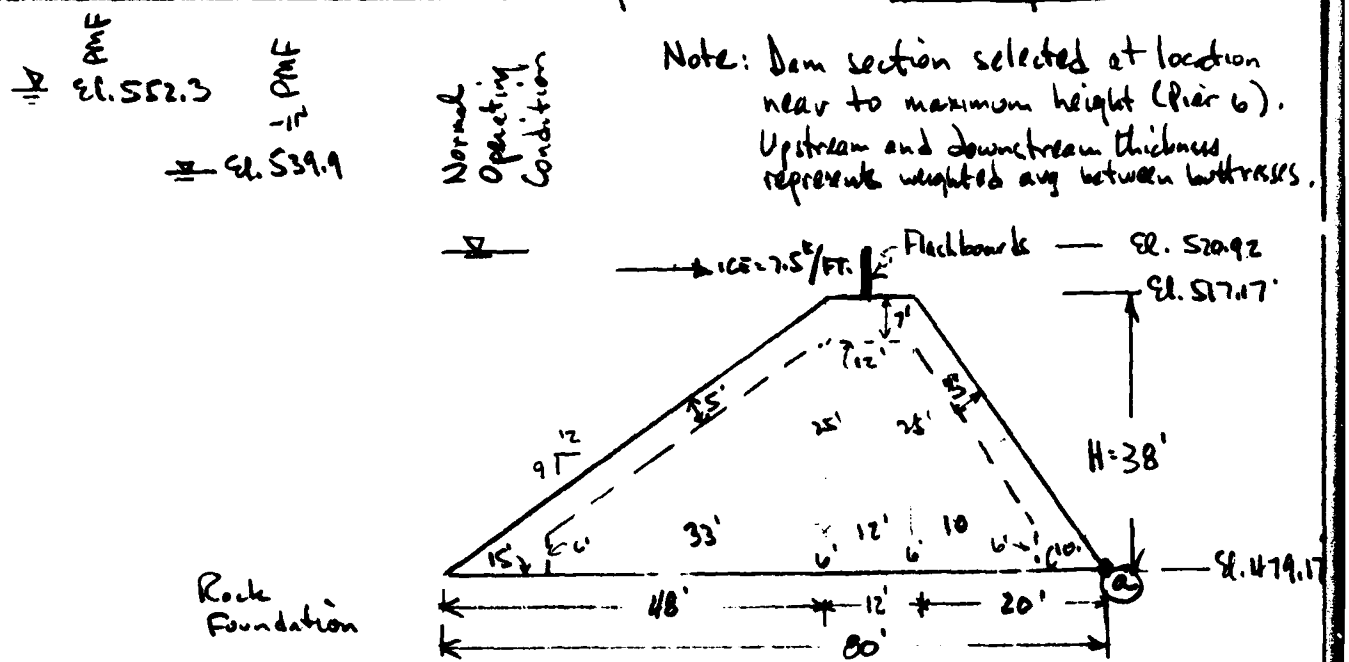
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.20	529.78	0.00	518.	52681.	0.00	85.00	0.00
0.30	534.07	2.37	615.	84965.	26.00	86.00	0.00
0.40	537.11	5.41	685.	113023.	45.00	86.00	0.00
0.50	539.84	8.14	748.	140777.	59.00	86.00	0.00
0.60	542.51	10.81	816.	168640.	71.00	86.00	0.00
0.80	547.56	15.86	946.	225123.	91.00	86.00	0.00
1.00	552.27	20.57	1066.	282567.	94.00	86.00	0.00

APPENDIX D

STABILITY ANALYSIS

Assumed Cross-Section and Loading Conditions - Easterly Section

Note: Dam section selected at location near to maximum height (Pier 6). Upstream and downstream thickness represent weighted avg between buttresses.



Note 19' cc between buttresses, buttresses 4' wide Use section of dam 19' long

Wt. of 19' long section $= (19')\left[\overset{912}{(\tfrac{1}{2}\times 48\times 38)} + \overset{456}{(12\times 38)} + \overset{380}{(\tfrac{1}{2}\times 20\times 38)}\right](0.150^k/ft^3) -$

$-(15'\times .15^k/ft^3)\left[\overset{413}{(\tfrac{1}{2}\times 33\times 25)} + \overset{300}{(12\times 25)} + \overset{125}{(\tfrac{1}{2}\times 10\times 25)} + \overset{330}{(55\times 6)}\right] =$

$= 4982 - 2628 = \underline{2354^k}$

M_a due to mass of 19' long section $= (19\times .15)\left[\overset{43776}{(912)(\tfrac{48}{3}+32)} + \overset{11856}{(456)(\tfrac{12}{2}+20)} + \overset{5067}{(380)(\tfrac{2}{3}\times 20)}\right] -$

$-(15\times .15)\left[\overset{17759}{(413)(\tfrac{33}{3}+32)} + \overset{7800}{(300)(\tfrac{12}{2}+20)} + \overset{2083}{(125)(\tfrac{20}{3}+10)} + \overset{12375}{(330)(\tfrac{55}{2}+10)}\right]$

$= 172{,}991^{1k} - 90{,}038^{1k} = \underline{82{,}953}^{1k}$

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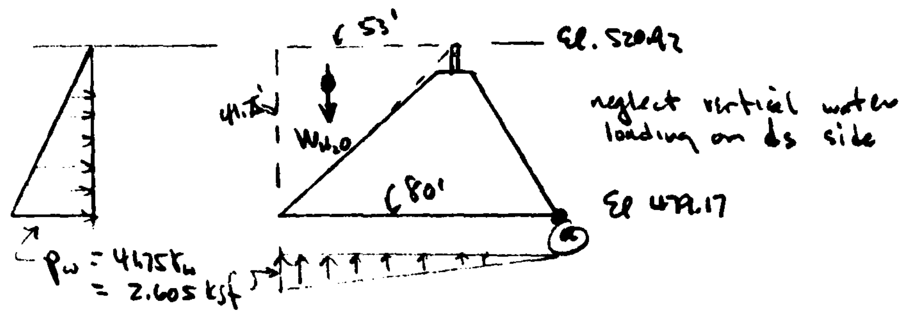
PROJECT NAME PALMER FALLS DATE

SUBJECT PROJECT NO.

DRAWN BY

Easterly Section

Case I: WL @ Normal Operating Level (Top of Flashboards)



(a) M_a causing overturning due to lateral H_2O pressure $= (19')\left(2.605 \times \frac{41.75}{2} \times \frac{41.75}{3}\right)$
no uplift

$(19)(757^{k}) = 14{,}383^{k}$/per 19'

$W_{H_2O} = 81764$

FS against overturning: $\dfrac{82{,}953^{1k} + (19)\left(\frac{1}{2} \times 41.75 \times 53 \times .0624\right)\left(\frac{106}{3} + 27\right)^{1k}}{14{,}383^{1k}} = \dfrac{164{,}717}{14{,}383} = 11$

(b) M_a causing overturning, assuming uplift on entire base area (assume base slab of rock/concrete acts as raft)

$= 14{,}383^{k} + (19)\left(2.605 \times \frac{80}{2} \times \frac{160}{3}\right) = 119972$ ^{1k}/per 19'

FS against overturning $= \dfrac{164{,}717}{119{,}972} = \underline{1.37}$

Position of Resultant, R: $d = \dfrac{\Sigma M_{tn}}{\Sigma V}$

$d = \dfrac{(164{,}717 - 119{,}972)}{(2354) + \left(19 \times \frac{1}{2} \times 41.75 \times 53 \times .0624\right) - \left(\frac{1}{2} \times 80 \times 2.605 \times 19\right)} = \dfrac{44{,}745}{1686} = 26.54' = 0.3$

3/

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DRAWN BY

Sliding - friction/shear method, use 50 psi bond conc/rock

$$FS = \frac{\mu V + (\text{contact area} \times \text{bond})}{\text{forces causing sliding (wt. } H_2O \text{ only)}}$$

$$\underline{FS} = \frac{(0.65 \times 1686) + [(4\times80)+(20\times15)](050 \times 144 \frac{psi}{ft^2})}{(19')(\frac{1}{2} \times 41.75 \times 2.605)} = \frac{1096 + 5504}{1034} = \underline{6.4 \pm}$$

4/

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SUBJECT PROJECT NO.

DRAWN BY

Case II. WL @ Top of Flashboards, Ice Acting

assume ice loading of 7.5k/lineal ft x19' @ height of 37'

Overturning

(a) FS against overturning = $\frac{164{,}717}{(119{,}972^k)+(7.5^k/ft \times 19' \times 37')} = \frac{164{,}717}{125{,}245} = \underline{1.32}$

5273

Position of Resultant, R: d = $\frac{(164{,}717-125{,}245)}{(1686)}$ = 23.4' = $\underline{0.30\ b}$

(b) Sliding - friction/shear method

$$FS = \frac{\mu V + (\text{contact area} \times \text{bond})}{\text{forces causing sliding}_{H_2O + ice}}$$

$$= \frac{(0.65 \times 1686) + (4' \times 80' \times .050^{psi\ bond} \times 144 \frac{in^2}{ft^2})}{19'\left[\left(\frac{1}{2} \times 41.75 \times 2.605\right) + 7.5\right]} = \frac{1096 + 2304}{1176^k} = 3 \pm (\text{low})$$

PROJECT NAME PALMER FALLS DATE
SUBJECT PROJECT NO.
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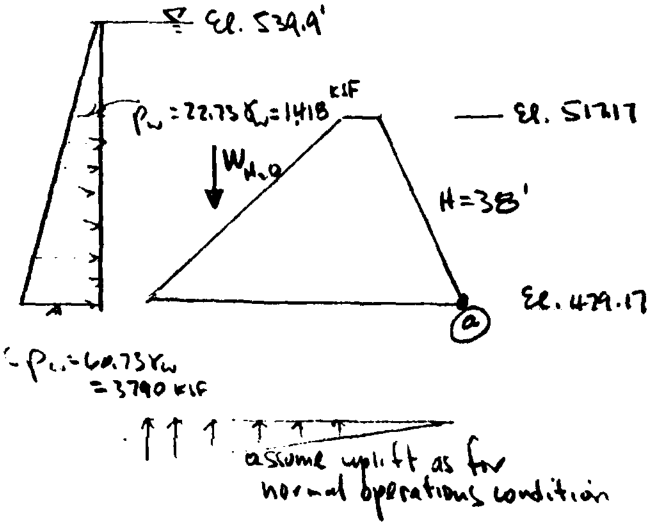
Case III: WL @ $\frac{1}{2}$ PMF Elevation, Flashboards Failed



(a) assume weight water on upstream face as for normal operations case, uplift as for normal operations case, lateral H_2O pressure increases

M_a causing overturning $= (19)(1.418 \times 38 \times \frac{38}{2}) + 119{,}972^k = 139{,}424^k$
19452

FS against overturning $= \dfrac{164{,}717^k}{139{,}424^k} = \underline{1.18}$

Position of Resultant, R: $d = \dfrac{\Sigma M_a}{\Sigma V}$

$d = \dfrac{(164{,}717 - 139{,}424)^k}{(1686)^k} = 15.' = \underline{.19\ b}$

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b) assume weight on upstream face due to full height of water, normal uplift

additional M_a due to upstream weight water $= (53' \times 22.73 \times .0624)(27 + \frac{53}{2})$

$= 76,413^{1k}$

total M_a resisting overturning $= 164,717 + 76,413 = 241,130^{1k}$

FS against overturning $= \frac{241,130}{139,424} = \underline{1.73}$

Position of Resultant, R : $d = \frac{\Sigma M_a}{\Sigma V}$

$\underline{d} = \frac{(241,130 - 139,424)}{1686 + (19)(53 \times 22.73 \times .0624)}$ $\frac{101,706^{1k}}{3114^{k}} = 32.7' = \underline{0.41\ b}$

1428

c) assume uplift results from full height of upstream water level

$\therefore M_a$ due to uplift $= (19)(3.790 \times \frac{80}{2})(\frac{2 \times 80}{3}) = 153,621^{1k}$

Extra M_a due to increased uplift $= 153,621^{1k} - 105,590^{1k} = 48,031^{1k}$

Total M_a causing overturning $= 139,424 + 48,031 = 187,455^{1k}$

FS against overturning $= \frac{241,130^{1k}}{187,455^{1k}} = \underline{1.29}$

Position of Resultant, R : $d = \frac{\Sigma M_a}{\Sigma V}$

$\underline{d} = \frac{(241,130 - 187,455)}{2354 + (1312 + 1428) - (\frac{1}{2} \times 3.79 \times 80 \times 19)} = \frac{53,675}{(5094 - 2880)^k} = 24.2' = \underline{0.31\ b}$

dam H_2O on top uplift 2880 2214

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Sliding - for conditions of case (c)

$$FS = \frac{\mu V + \text{bond/shear}}{\text{forces causing sliding}} =$$

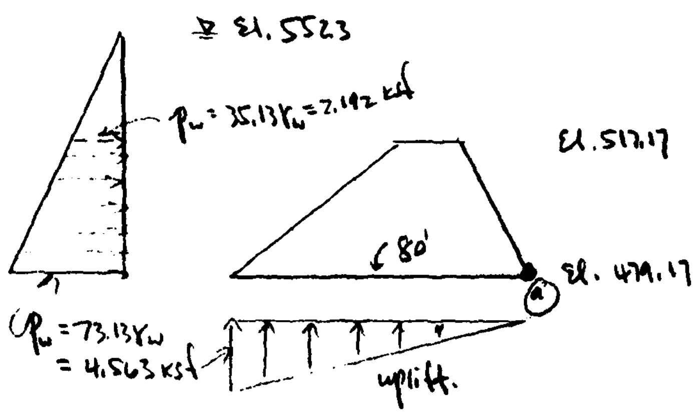
$$= \frac{(0.65)\left[2354 + 1312 + \overset{1428}{(22.73 \times 53 \times .0624 \times 19)} - \overset{2880}{(19)(3.79 \times \frac{80}{2})}\right] + \left[(4 \times 80) + (25 \times 15)\right](.05 \times 144)}{(19)\left(\frac{1.418 + 3.790}{2}\right)(38)}$$

$$FS = \frac{(0.65)\left[2354 + 1312 + \overset{1440}{1428} - 2880\right] + 5004}{(1880)} = \underline{3.5} \text{ (slightly low)}$$

for conditions of case (b)

$$FS = \frac{(0.65)\left[2354 + 2740 - 1980\right] + 5004}{(1880)} = \frac{2024 + 5004}{1880} = \underline{3.75\pm}$$

Case IV. WL @ PMF Elevation, Flashboards Failed



1. assume weight of water on upstream face due to full height of water, assume uplift results from full height of upstream water level

M_a causing overturning due to lateral H_2O, uplift

$$= (19)\left[\left(2.192 \times 38 \times \frac{38}{2}\right) + (4.563-2.192)\left(\frac{38}{2}\right)\left(\frac{38}{3}\right)\right] + (19)\left[\left(4.563 \times \frac{80}{2}\right)\left(\frac{160}{3}\right)\right] =$$

$$= 40{,}919 + 184{,}954 = 225{,}873^{1K}$$

M_a resisting overturning due to mass of dam, H_2O vertical on upstream face

$$= 82{,}953^{1K} + 81{,}764^{1K} + (35.13 \times 53 \times .0624)\left(\frac{53}{2} + 27\right)(19) = 282{,}817^{1K}$$

FS against overturning $= \dfrac{282{,}817^{1K}}{225{,}873^{1K}} = \underline{1.25}$

Position of Resultant R : $d = \dfrac{\Sigma M_a}{\Sigma V}$

$$d = \frac{(282{,}817 - 225{,}873)}{2354 + [1312 + (35.13 \times 53 \times .0624)] - (19)\left(4.563 \times \frac{80}{2}\right)} = \frac{56{,}944^{1K}}{2405^{K}} = 23.7' = \underline{0.30b}$$

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(b) conditions as for case (a) except uplift as for normal operating level

M_a causing overturning due to lateral water pressure, normal uplift

$= 40{,}919^{'k} + 105{,}590^{'k} = 146{,}509^{'k}$

M_a resulting overturning $= 282{,}817^{'k}$

FS against overturning $= \dfrac{282{,}817^{'k}}{146{,}509^{'k}} = \underline{1.93}$

Position of Resultant, R : $d = \dfrac{\Sigma M_a}{\Sigma V}$

$\underline{d} = \dfrac{(282{,}817 - 146{,}509)}{2354 + 1312 + 2207 - 1980} = \dfrac{136{,}308}{3893} = 35' = \underline{0.44b}$

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Sliding - case (a)

$$FS = \frac{\mu V + \text{bond}/\text{shear}}{\text{forces causing sliding}} =$$

$$= \frac{(0.65)\left[2354 + 1312 + \overset{2207}{(19 \times 35.13 \times 53 \times .0624)} - \overset{7468}{\left(19 \times 4.563 \times \tfrac{80}{2}\right)}\right] + 5004}{(19)\left(\frac{2.192 + 4.563}{2}\right)(38)}$$

$$\underline{FS =} \frac{(0.65)(\overset{1563}{2405}) + 5004}{2439} = \frac{6567}{2439} = \underline{2.7} \text{ (low)}$$

case b

$$\underline{FS} = \frac{(0.65)\left[\overset{2530}{3893}\right] + 5004}{2439} = \frac{7534}{2439} = \underline{3.1} \text{ (low)}$$

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Case V – Normal Operating Level, No Ice, Seismic Applicable to Zone 2 Added overturning

Additional M_a due to inertial effects on mass of dam and water

(i) M_a due to horiz. acceleration effects of 0.05 G on mass of dam

$$=(19\times.05)\left[\left(\tfrac{1}{2}\times48\times38\times.15\times\tfrac{38}{3}\right)^{1733}+\left(12\times38\times.15\times\tfrac{38}{2}\right)^{1300}+\left(\tfrac{1}{2}\times20\times38\times.15\times\tfrac{38}{3}\right)^{722}\right]-$$

$$-(15\times.05\times.15)\left[\left(\tfrac{1}{2}\times33\times25\times(\tfrac{25}{3}+6)\right)^{6000}+\left(12\times25\right)\left(\tfrac{25}{2}+6\right)^{5550}+\left(\tfrac{1}{2}\times25\times10\times(\tfrac{25}{3}+6)\right)^{1788}+\left(55\times6\times3\right)^{990}\right]$$

$$=3755-1612=2143^{1k}$$

(ii) M_a due to vertical acceleration effects of 0.025 G on dam mass

$$=(19\times.025\times.15)\left[\left(\tfrac{1}{2}\times48\times38\times(\tfrac{48}{3}+32)\right)^{43776}+\left(12\times38\times26\right)^{11856}+\left(\tfrac{1}{2}\times20\times38\times\tfrac{40}{3}\right)^{5067}\right]-$$

$$-(15\times.025\times.15)\left[\left(\tfrac{1}{2}\times25\times33\right)\left(\tfrac{33}{3}+32\right)^{17738}+\left(12\times25\right)(26)^{7800}+\left(\tfrac{1}{2}\times25\times10\right)\left(10+\tfrac{20}{3}\right)^{2088}+\left(55\times6\right)\left(\tfrac{55}{2}+\ldots\right)^{12375}\right]$$

$$=4325^{1k}-2250^{1k}=2075^{1k}$$

(iii) M_a due to horiz. acceleration/wave action of water (face @ 53° to vertical)

$$M_a=(0.37)(.05)(.0624\times41.75)(41.75\times41.75)(.30)(19')=479^{1k}$$

Extra M_a total $=2143+2075+479=4697^{1k}$

<u>FS</u> against overturning $=\dfrac{(164,717)}{(119,972+4697)}_{124,669}=\underline{1.32}$

Position of Resultant R : $d=\dfrac{\Sigma M_a}{\Sigma V}$

$$d=\frac{164,717-124,669}{\ldots-1772-(\ldots1317)(.025)}=\frac{40,048}{1595}=25.1'=0.31\ b$$

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Sliding

Additional horizontal force due to inertial effects on dam and water

$$\Delta H_{dam} = .05 W_{dam} = .05(2354) = 118^{k}$$

$$\Delta H_{H_2O} = (0.73)(0.37)(.05 \times .0624 \times 41.75)(41.75)(19') = 28^{k}$$

$$\text{FS against sliding} = \frac{(.65)\overset{1037}{\boxed{1595}} + 5004}{(1034 + 118 + 28)} = \frac{6041}{1180} = \underline{5.1} \pm$$

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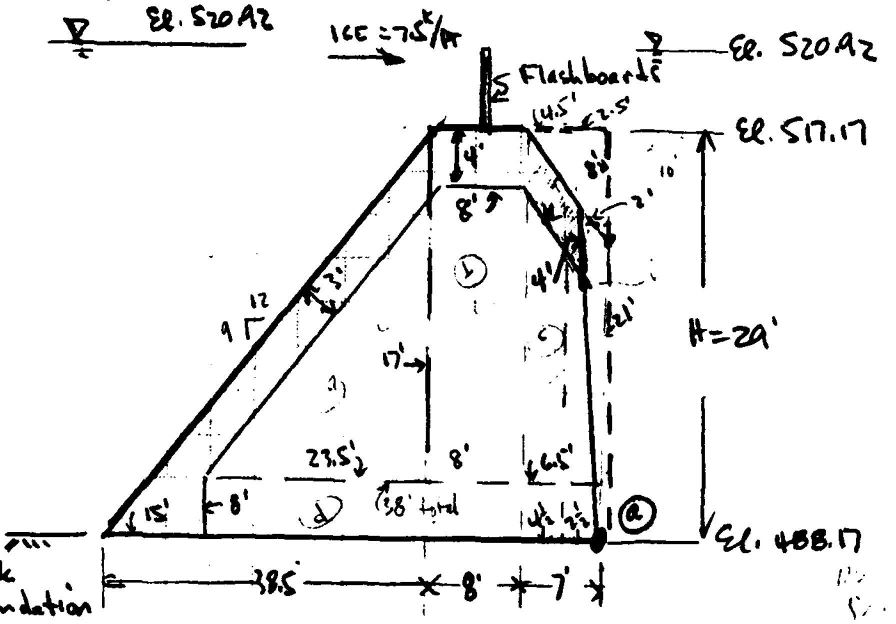
Assumed Cross-Section and Loading Conditions - Westerly Section

Note: 19' cc between buttresses, buttresses 4' wide, use section 19' long.

PMF El. 552.3
½ PMF El. 539.9
Normal Operating Condition El. 520.92



Wt. of 19' long section $= (19' \times .15)\left[\left(\tfrac{1}{2}\times 38.5\times 29\right) + (15\times 29) - \left(\tfrac{1}{2}\times 7\times 8\right) - \left(\tfrac{1}{2}\times 2\times 21\right)\right] -$

$- (15' \times .15)\left[\left(\tfrac{1}{2}\times 17\times 23.5\right) + (8\times 17) + \left(\tfrac{6.5+5}{2}\right)\left(\tfrac{17+13}{2}\right) + (37.5\times 8)\right] =$

$= (19\times .15\times 944.3) - (15\times .15)(722) = \underline{1065^{k}}$

(2691) (1625)

M_a due to mass of 19' long section $= (19\times .15)\left[(558.3)\left(\tfrac{38.5}{3}+15\right) + \left(435\times \tfrac{15}{2}\right) - \left(28\times \tfrac{7}{3}\right) - \left(21\times \tfrac{2}{3}\right)\right]$

$- (15\times .15)\left[(199.8)\left(\tfrac{23.5}{3}+15\right) + (136)(44.7) + (86)\left(\tfrac{6.5}{2}+2.5\right) + (300\times 19)\right]$

$= (19\times .15)(18723) - (15\times .15)(12167) = \underline{25{,}985}^{\,1k}$

(53361) (27376)

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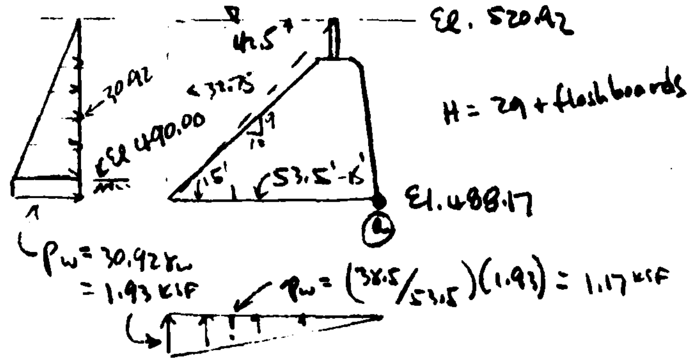
Westerly Section

Case I . WL @ Normal Operating Condition (Top of Flashboards), No Ice



Overturning – case (a), uplift acting on entire plan area of dam

M_a causing overturning due to lateral H_2O pressure, uplift (assume base slab of rock/concrete acts as raft)

$$=(19)\left[\left(1.93 \times \frac{32.75}{2}\right)\left(\frac{32.75}{3}\right) + \left(1.93 \times \frac{53.5}{2}\right)\left(\frac{2 \times 53.5}{3}\right)\right] = 41{,}483^{'K}$$

M_a resisting overturning due to mass of dam, wt. H_2O on upstream face

$$= 25{,}985^{'K} + \left(\tfrac{1}{2} \times 42.5 \times 32.75 \times .0624\right)\left(\tfrac{2}{3} \times 42.5 + 11\right)(19) = 58{,}442^{'K}$$

$$\text{FS against overturning} = \frac{58{,}442}{41{,}483} = \underline{1.41}$$

Position of Resultant R: $d = \dfrac{\Sigma M_o}{\Sigma V}$

$$\underline{d} = \frac{(58{,}442 - 41{,}483)}{1065 - \left(\tfrac{1}{2} \times 1.93 \times 53.5\right)(19) + \left(\tfrac{1}{2} \times 42.5 \times 32.75 \times .0624\right)(19)} = \frac{16{,}959^{'K}}{910^{K}} = \underline{18.6' = 35}$$

dam 980 uplift H_2O 825

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Overturning – case (b), uplift acting on foundation contact area only

M_a due to uplift = $34,986^k - (15)(1.17 \times 38.5 \times \frac{1}{2})(\frac{2}{3} \times 38.5) = 26,315^{1k}$

8671

total M_a causing overturning = $\underset{\text{uplift } H_2O}{6497} + 26,315 = 32,812^{1k}$

FS against overturning = $\frac{58,442}{32,812}$ = 1.78

Position of Resultant, R : d = $\frac{\Sigma M_a}{\Sigma V}$

$$d = \frac{(58,442 - 32,812)}{\underset{\text{}}{1065} + \underset{H_2O \text{ on top}}{825} - [980 - (1.17 \times \frac{38.5}{2} \times 15)]} = \frac{25,630}{1248^k} = 20.5' = 0.38$$

980 − 338 = 642

Sliding – case (b) (least foundation contact area)

FS against sliding = $\frac{\mu V + \text{shear/bond at fdtn}}{\text{forces causing sliding}}$

$$FS = \frac{(0.65)(\overset{811}{1065 + 825 - 642}) + [\overset{785 \text{ contact area}}{(19 \times 15) + (4 \times 38.5)}](.05 \times 144 \frac{k}{ft^2})}{(19 \times 1.93 \times \frac{30.92}{2})} = \frac{3972}{567} = 7$$

case (a)

$$FS = \frac{(0.65)(910) + (19 \times 53.5)(.05 \times 144 \frac{k}{ft^2})}{567} = \frac{7911}{567} = 14^{\pm}$$

uplift on entire

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Case II. WL @ Top of Flashboards, Ice Load Acting

assume ice loading of $7.5^k/ft. \times 19'$ @ height of 31.75'

Overturning (case a)

$$FS \text{ against overturning} = \frac{58,442^{k}}{41,483+\underbrace{(7.5\times19\times31.75)}_{4524}} = \frac{58,442}{46,007} = \underline{1.27}$$

$$\text{Position of Resultant, R}: \underline{d} = \frac{\Sigma M_a}{\Sigma V} = \frac{(58,442 - 46,007)}{910} = 13.7' = \underline{0.26}\,b$$

Overturning (case b)

$$FS \text{ against overturning} = \frac{58,442}{(37,812+4524)} = \frac{58,442}{37,336} = \underline{1.57}$$

$$\text{Position of Resultant, R}: d = \frac{\Sigma M_a}{\Sigma V} = \frac{(58,442-37,336)}{1248} = 16.9' = \underline{.32}\,b$$

Sliding (case b)

$$FS \text{ against sliding} = \frac{3914}{567+\underbrace{(7.5\times19)}_{142.5}} = \frac{3914}{709.5} = \underline{5.5}\pm$$

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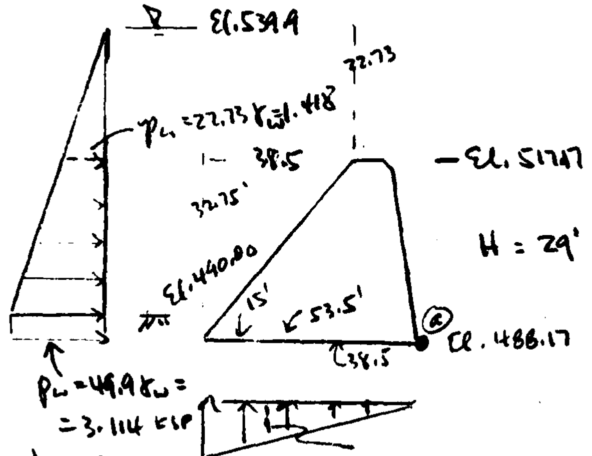
Case III. WL @ ½ PMF Elevation, Flashboards Failed



worse condition

Overturning

M_a causing overturning due to horiz. H_2O pressure, normal uplift on entire plan area

$= (19)\left[\left(1.418 \times 32.75 \times \frac{32.75}{2}\right) + \left(1.93 \times \frac{32.75}{2} \times \frac{32.75}{3}\right)\right] + 34{,}986 = 55{,}990^{1k}$

lateral H_2O 51,005 uplift

M_a resisting overturning due to mass of dam, wt. H_2O on top dam

$= 25{,}985 + 19\left[\left(\tfrac{1}{2} \times 32.75 \times 38.5 \times .0624\right)\left(\frac{38.5}{3} + 15\right) + \left(22.73 \times 38.5 \times .0624\right)\left(\frac{38.5}{2} + 15\right)\right] =$

1090 1884

$= 25{,}985 + 56{,}506 = 82{,}491^{1k}$

FS against overturning $= \dfrac{82{,}491^{1k}}{55{,}990^{1k}} = 1.47$

Position of Resultant, R : $d = \dfrac{\Sigma M_a}{\Sigma V}$

$d = \dfrac{(82{,}491 - 55{,}990)}{1065 + (38.5)\left(\frac{22.73 + 51.23}{2}\right)(.0624)(19) - \left(1.93 \times \frac{53.5}{2}\right)(19)} = \dfrac{26{,}501}{1784} = 14.9' = 0.28$

1700 951

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Sliding - case a

$$FS = \frac{\mu V + \text{shear/bond at fdtn contact}}{\text{forces causing sliding}}$$

where V = 1065 − 642 + $\left(\frac{1}{2} \times 32.75 \times 38.5 \times .0624\right)$ + $(22.73 \times 38.5 \times .0624)$ =
= 1065 − 642 + (39 + 55)(19) = 2201

$$FS = \frac{(0.65)(2201^k) + 3161^k}{(19)\left(\frac{1.418 + 3.114}{2}\right)(32.75)} = \frac{4592}{1410} = \underline{3.3\pm} \quad (\text{low})$$

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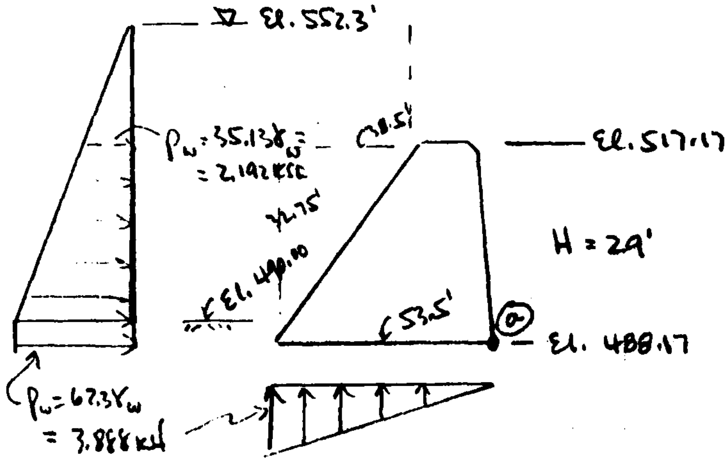
Case IV · WL @ PMF Elevation, Flashboards Failed



Overturning

M_a causing overturning due to horiz. H_2O pressure, normal uplift on entire plan area (worse condition)

$= (19)\left[\left(2.192 \times 32.75 \times \frac{32.75}{2}\right) + \left(1.93 \times \frac{32.75}{2} \times \frac{32.75}{3}\right)\right] + 34,986^{k} = 63,876^{k}$

1176 28,890 345 uplift

M_a resisting overturning due to mass of dam, wt. H_2O on top dam

$= 25,985 + 19\left[\left(\frac{1}{2} \times 32.75 \times 38.5 \times .0624\right)\left(\frac{38.5}{3} + 15\right) + \left(35.13 \times 38.5 \times .0624\right)\left(\frac{38.5}{2} + 15\right)\right] =$

1000 78.11

$= 25,985 + 75,631 = 101,616^{k}$

<u>FS against overturning</u> $= \frac{101,616^{k}}{63,876^{k}} =$ <u>1.59</u>

Position of Resultant, R : $d = \frac{\Sigma M_a}{\Sigma V}$

$d = \frac{(101,616 - 63,876)}{1065 + (38.5)\left(\frac{67.3 + 35.13}{2}\right)(.0624)(19) - 981} = \frac{37,740}{2308} = 16.4' = \underline{0.31\ b}$

dam H₂O on top 2224 uplift

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Sliding

$$FS = \frac{\mu V + \text{shear/bond at fdtn contact}}{\text{forces causing sliding}}$$

where $V = \overset{\text{wt dam}}{1065} - \overset{\text{uplift}}{642} +$
$+ 19[39 + (35.13 \times 38.5 \times .0624)] =$
$= 1065 - 642 + 2345 = 2768^k$

$$F_S = \frac{(0.65)(\overset{1500\ \text{wt2}}{2768}) + \overset{1800}{3161}^{k}}{(19)\left(\frac{2.192 + 3.89}{2}\right)(32.75)} = \frac{4960}{1736} = \underline{2.9 \pm}$$

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Case V. Normal Operating Level, No Ice, Seismic Applicable to Zone 2 Added

Overturning

Additional M_a due to inertial effects on mass of dam and water

(i) M_a due to horiz acceleration effects of 0.05 G on mass of dam

$$= (19 \times .05 \times .15)\left[\left(\overset{5377}{\tfrac{1}{2} \times 38.5 \times 29 \times \tfrac{29}{3}}\right) + \left(\overset{6308}{15 \times 29 \times \tfrac{29}{2}}\right) - \overset{736}{\left(\tfrac{1}{2} \times 7 \times 8\right)\left(21 + \tfrac{16}{3}\right)} - \left(\tfrac{1}{2} \times 2 \times 21\right)\left(\tfrac{42}{3}\right)\right]$$

$$- (15 \times .05 \times .15)\left[\left(\tfrac{1}{2} \times 17 \times 23.5\right)\left(8 + \tfrac{17}{3}\right) + \overset{2244}{(8 \times 17)\left(\tfrac{17}{2} + 8\right)} + \overset{1978}{\left(\tfrac{6.5+5}{2}\right)}\overset{36}{\left(\tfrac{17+13}{2}\right)}(8+15) + \overset{1200}{(37.5 \times 8)}(\ldots)\right]$$

$$= (19 \times .05 \times .15)[10672] - (15 \times .05 \times .15)[8155] = 1521 - 917 = 604^{1k}$$

(ii) M_a due to vertical acceleration effects of 0.025 G on mass of dam

$$= 0.025\,(25{,}985) = 650^{1k}$$

(iii) M_a due to horiz. acceleration/wave action of water (dam face @ 53° to vertical)

$$M_a = (\overset{c}{0.37})(.05)(.0624 \times 30.92)(30.92 \times 30.92)(.30)(19) = 195^{1k}$$

Extra M_a total due to seismic effects $= 604 + 650 + 195 = 1449^{1k}$

FS against overturning $= \dfrac{58{,}442}{41{,}483 + 1{,}449} = \dfrac{58{,}442}{42{,}932} = \underline{1.36}$

Position of Resultant, R : $\underline{d} = \dfrac{(58{,}442 - 42{,}932)}{\underset{1248}{910} - (\underset{\text{wt. dam}}{1065} + \underset{\text{H}_2\text{O}}{825})(\underset{47}{.025})} = \dfrac{15510}{\underset{1200}{863}} = \overset{13}{18'} = \overset{.25\,b}{\underline{0.34\,b}}$

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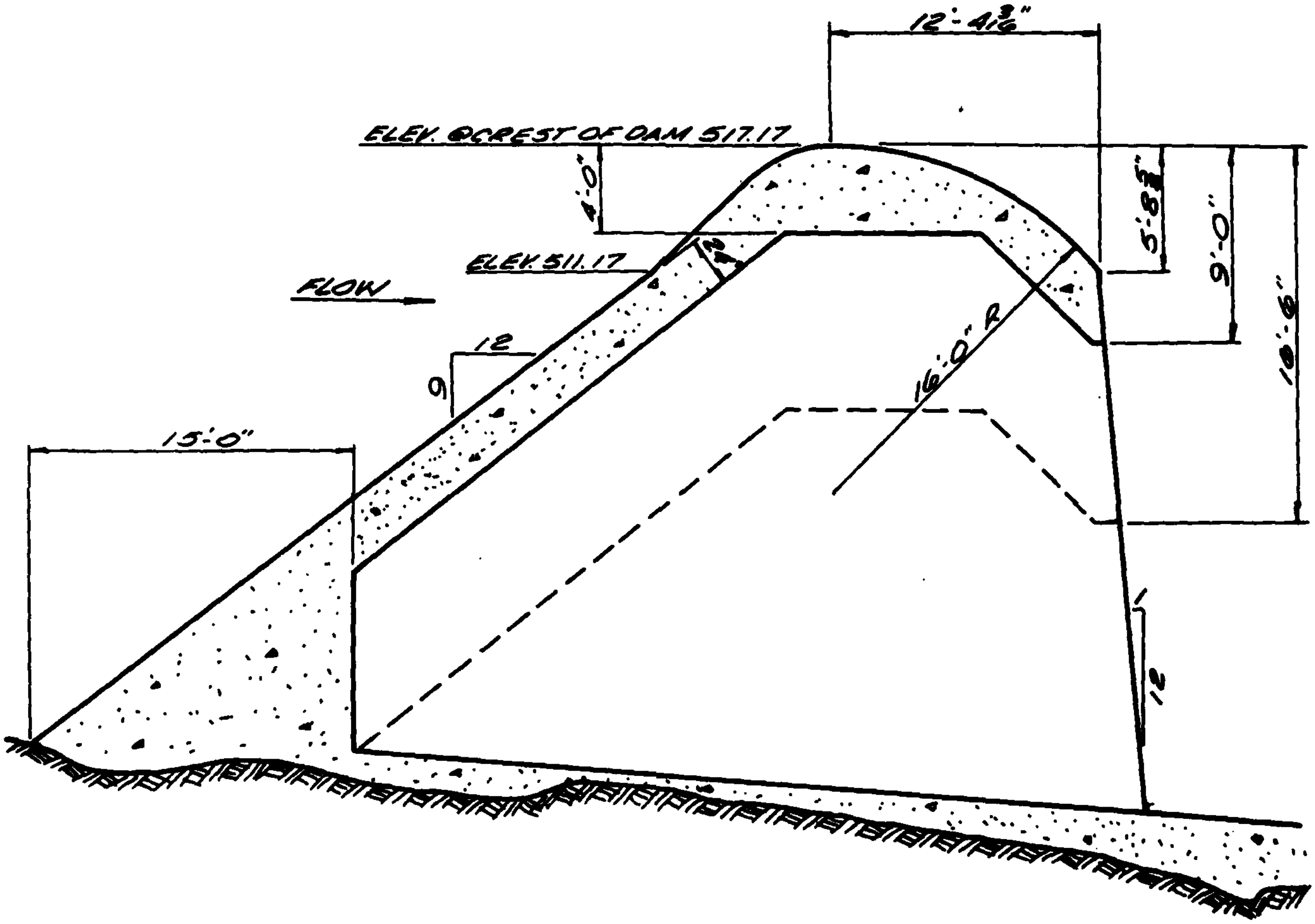
Sliding

Additional horiz. force due to inertial effects on dam and water

$$\Delta H_{dam} = .05 W_{dam} = .05(1065^k) = 53^k$$

$$\Delta H_{H_2O} = (0.73)(0.37)(.05 \times .0624 \times 30.92)(30.92)(19') = 11^k$$

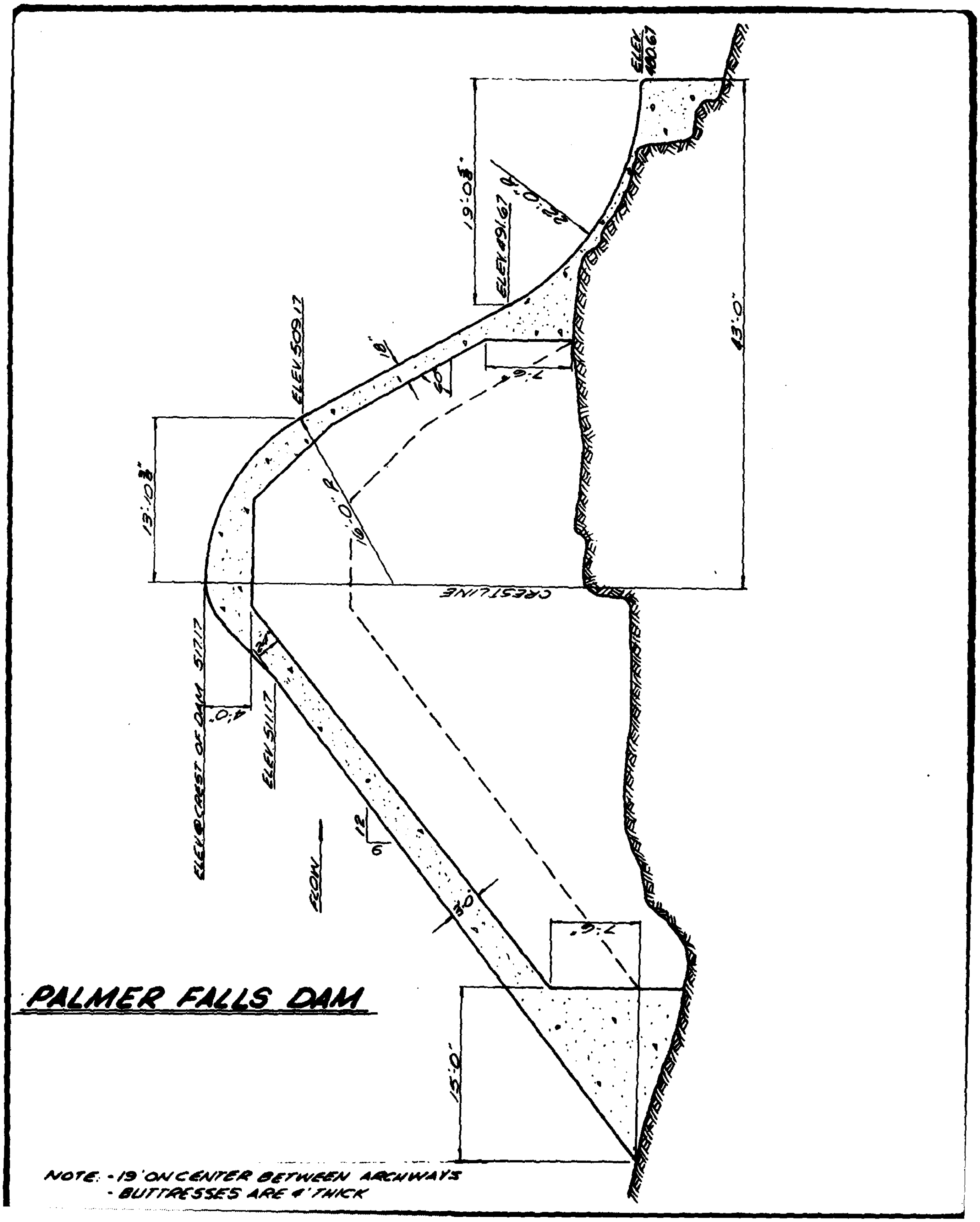
$$\text{FS against sliding} = \frac{(0.65)(\overset{794}{1248} - \overset{.025 W_{dam}}{27}) + 3161}{(567 + 53 + 11)} = \frac{3955}{631} = \underline{6} \pm$$



PALMER FALLS DAM

1/8" = 1'-0"

NOTE: - 19' ON CENTER BETWEEN ARCHWAYS
- BUTTRESSES ARE 4' THICK



PALMER FALLS DAM

NOTE: - 19' ON CENTER BETWEEN ARCHWAYS
- BUTTRESSES ARE 4' THICK

APPENDIX E

REFERENCES

APPENDIX

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